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Retread Construction in Indiana

Method of Constructing Bituminous Retread Top on Old Gravel or Stone Roads or Other Types of Surfaces That Have Become Rough or Disintegrated

By A. H. HINKLE

Superintendent of Maintenance, Indiana State Highway Commission, Indianapolis, Ind.

DURING the past year our state highway commission faced about 90 miles of old roads with bituminous retread top.

I know of no road surface that fits in the gap between the traffic bound surface and the higher priced pavement any better than the surface we term "Bituminous Retread Top." This surface can be constructed very smooth. It is dustless and easily maintained and maintenance costs are not high when the old road to be reclaimed has sufficient width and strength.

The bituminous retread top, with this paper is primarily concerned, as we have been building it, consists of a mixture of bituminous material and crushed stone, slag or gravel, made by several applications of the bituminous material to a layer of the aggregate spread on the old road. The mixture is kept smooth and uniform by the use of a grader or planer, until the bituminous material hardens sufficiently to cause the aggregate to compact under a roller. The aggregate is rolled after the applications when the bituminous material is in the proper stage of curing. The surface voids that can not be closed by rolling are filled with covering material (¾ in. aggregate), just preceding the third application of bituminous material.

Fig. 1—Applying Road Oil A to Gravel Road to Be Used as Base for Retread Top

Preparing the Old Road as a Base.—This bituminous retread top has been built on old brick and other types of pavements that have become objectionable because of roughness and disintegration. The holes and depressions in the old pavement were first properly patched. Generally it has been built on an old gravel or stone road. It may be placed on any kind of an old road that is sufficiently strong to carry the load that is to go over it. It may be necessary to level and strengthen the old gravel or stone road. This may be done very economically by adding a liberal application of metal the preceding fall, winter, or early spring, which is compacted by traffic and "drag maintenance"; or by the use of a roller and stone screenings added to coarse aggregate as in waterbound macadam work.

Use of Road Oil to Solidify Loose Material and "Level Up" Old Road Surface.—Our experience indicates that the cheapest building up, as well as leveling of the base, can be affected by treating the old road surface coated with 1 in. to 3 in. of loose aggregate (sized for ordinary drag maintenance) with ½ to

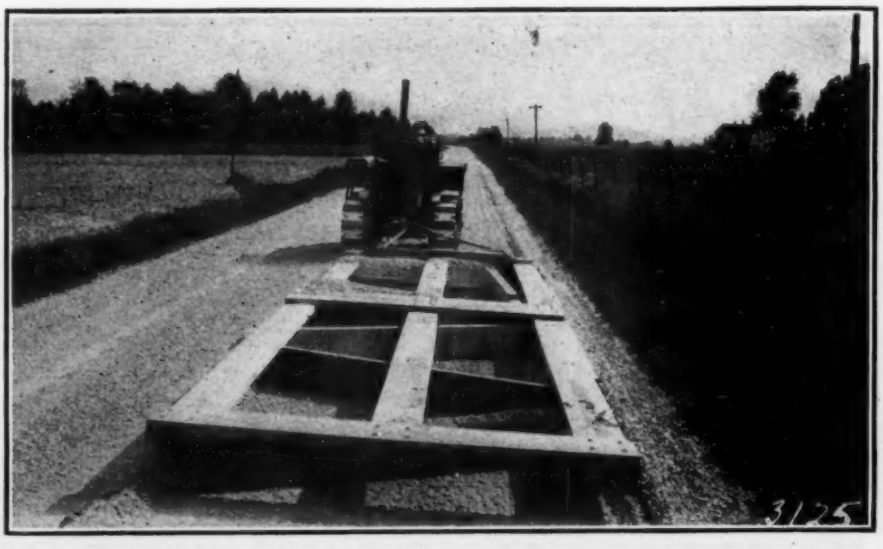


Fig. 2—Smoothing Oil-Treated Gravel Road by the Use of a 32-Ft. Drag. By This Process an Old Road Which Is Quite Rough Can Be Made Very Smooth Preparatory to Placing the Retread Top

Fig. 3—Patching "Potholes" Developed Under Traffic in Oiled Gravel Road by Use of Road Oil A and Gravel. The Oil Is Poured Into the Hole and Covered With Loose Gravel

¾ gal. per square yard of 40 to 70 viscosity road oil. The loose aggregate treated with the oil is spread and leveled over the surface with graders, planers and long base drags so as to make a perfectly smooth base on which to place the aggregate for the retread top. Superelevations and depressions in the old surface can be built up by successive applications of loose gravel or stone and the oil. The oil is of a sufficiently heavy grade to cement the loose aggregate and hold it in place after a few days' drying. Traffic may be permitted to use the road during this operation.

The use of road oil to solidify a layer of loose material on the old road is the most valuable feature put into practice in recent years in developing a low cost road that is better than a dragged type of surface. The oil gravel mixture not only adds strength to the base but it also forms a more or less impervious layer which sheds surface water and also breaks up the capillary attraction from the road base into the top course. It also greatly facilitates leveling the base and thus helps to obtain a smooth riding finished surface.

Aggregate and Spreading.—Aggregate consisting of a No. 2 (1½ in. to 2½ in.) or No. 3 (¾ in. to 1½ in.) size (the coarser size is preferable) is spread upon the base prepared as described above. The leveling of the aggregate is done by graders, drags, maintainers and harrows. The harrowing is necessary if the aggregate contains much fine material, as the harrowing operation will drop the fine material to the bottom and bring a more uniformly coarse aggregate to the surface, where it is most desirable in producing a uniform surface condition. It is always necessary to do a certain amount of hand finishing in trimming the edges and "spotting up" the low

Fig. 4—Dumping Stone From Truck for Retread Top. The Low Cost of This Type Is Largely Due to the Mechanical Operations Used in Spreading and Leveling the Aggregate

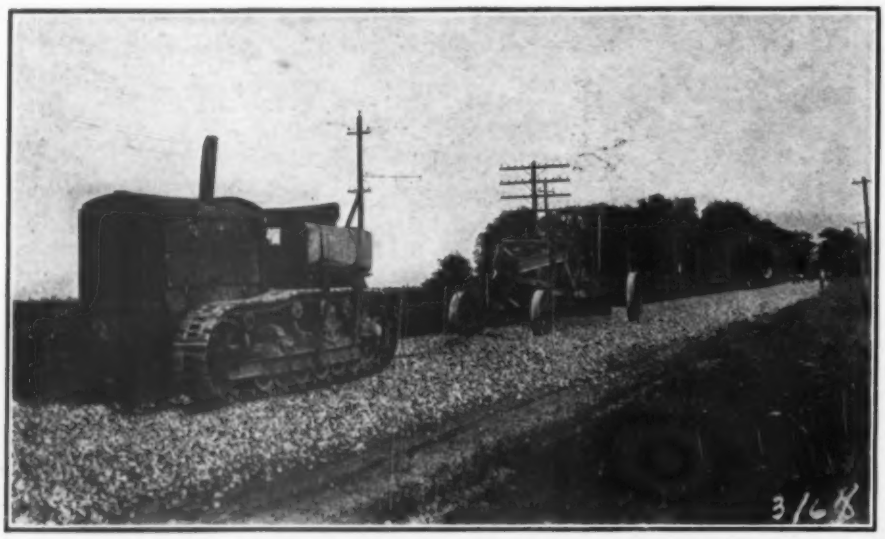


Fig. 5—Stone Dumped From Truck on Old Road Being Leveled by Use of Caterpillar Tractor and and Grader. In Rear Workmen Are Seen Trimming Edges and "Leveling Up"

places, that is, filling depressions with uncoated aggregate before the application of the bituminous material, or, with the bituminous coated aggregate after the application and when the rolling is in process. However, the cheapness of this type of surface is due largely to the mixing, spreading and leveling operations being done mechanically, which reduces the hand labor, and hence the cost, to a minimum.

If the coarse aggregate is a very hard stone it may be rolled one or more times before the first application of bituminous material. If a comparatively soft aggregate is used, no rolling should be done before the first application. There is little to be gained in rolling gravel before the first application.

The aggregate used for covering material should consist of a hard material of about No. 4 (¾ in.) size and is applied to the surface and swept into

the voids just preceding the third application of the bituminous material.

Amount of Bituminous Material.—The bituminous material is applied to the aggregate in at least three applications. More may be used. The total amount of bituminous material required as well as the amounts used in the different applications will vary with the depth of aggregate and hardness of the stone. As an example on our average limestone, the different applications of bitumen on 3½ in. of loose aggregate may be 0.4 gal. on the first, 0.3 gal. on the second, and 0.3 gal. the third coat, with perhaps a 0.2 gal. surface treatment applied before the following winter.

Grades of Bituminous Material.—Various grades of bituminous materials have been used in this class of work with very satisfactory results. The most common material we have used is material meeting our specifications for Liquid Asphalt CB (a cut back asphalt with specific viscosity 150 to 200 at 122° F.) and Tar TM (specific viscosity 30 to 60 at 40° C.). If the work is done in cool weather it is more desirable to use the more Liquid Asphalt AC (viscosity 50 to 100) which differs from the cut back only in the greater amount of distillate it contains. The lighter bitumen makes the aggregate more susceptible to mixing and leveling with the grader or planer. However, in warm weather the heavier grade of asphalt will give quicker results at slightly less cost.

Asphalt OH 2 has frequently been substituted for the liquid asphalts in the second application in order to reduce the cost. The OH-2 usually costs about two cents per gallon less than the liquid asphalts. Its use also permits the rolling about one day earlier. Since it is desirable to drag the covering material, it is necessary to again use the liquid asphalts for the third application.

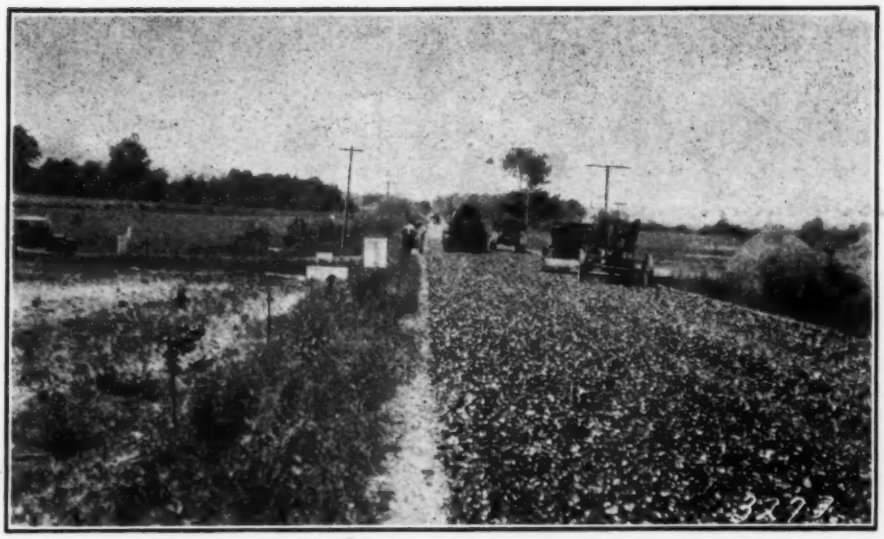


Fig. 7.—Blading After Harrowing to Smooth Surface Before Rolling

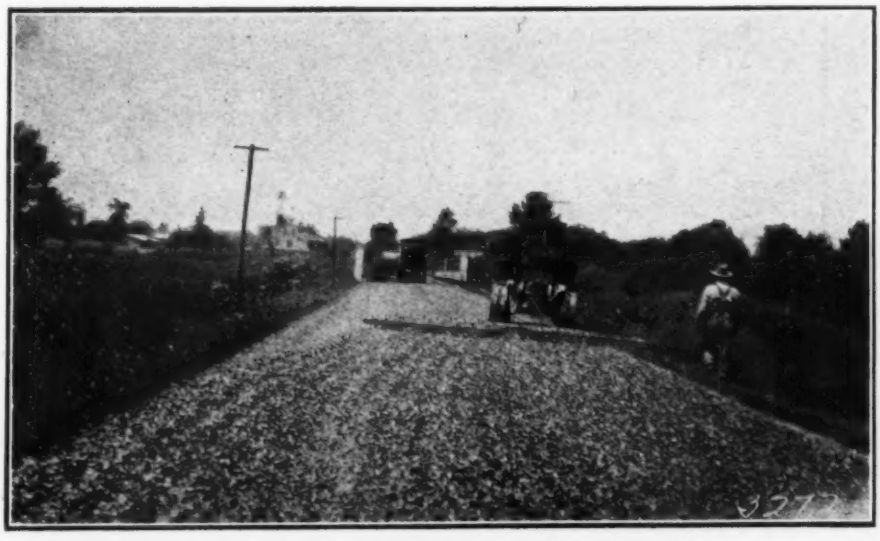


Fig. 6—Harrowing Retread After Application of Asphalt

Applying the Covering Material.—The covering is applied just preceding the third application of the bituminous material. It may be applied direct from a truck and swept over the surface by hand. The brushing of the covering into the voids may be done with a brush attached to a Ford car or light truck. An old carpet or tarpaulin dragged behind the truck will aid in properly placing the covering. The purpose of the sweeping is to roll the covering stone around over the surface until it drops into the voids of the coarser aggregate and fills all depressions thus producing as near a level surface as possible. After the third coat of bituminous material is applied, the surface is dragged with a light drag or maintainer, thus materially aiding in leveling the finished road. The size of covering stone may vary somewhat with the size of coarse aggregate, using

Fig. 8—Spreading the Covering Material and Brushing It Into the Voids With a Carpet and Brush Attached to a Ford Truck Just Preceding the Third Application of Bitumen

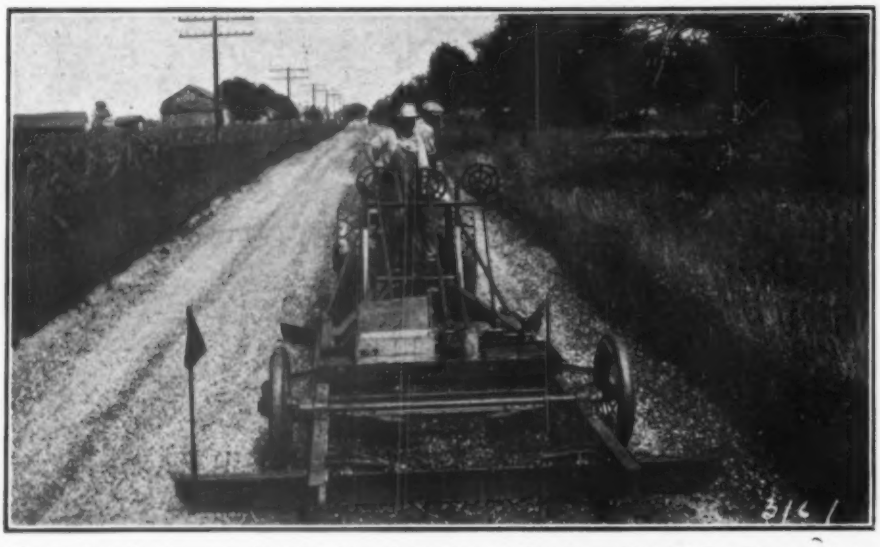


Fig. 9—Dragging Covering Material After Third Coat of Bituminous Material Has Been Applied. This Process Rolls the Coated Stone Around Until They Drop Into the Voids and Fill Any Little Irregularities in the Surface. After This Operation the Surface Is Thoroughly Rolled

a coarser material where the coarse aggregate leaves larger voids in the surface.

Rolling.—After each application of bituminous material the surface is rolled with a 10-ton, 3-wheel roller. In no case is covering material applied before the rolling. By this means a more uniform and smoother riding surface is produced than if covering material is applied between the application of bitumen and rolling. Water is applied to the roller wheels to prevent the bitumen from sticking to them. This rolling should be spread out over a number of days while the bitumen is hardening. The important time to secure the best results from the rolling is when the bitumen is sufficiently stiff and "tacky" to prevent the stone from being "mushed" out of shape by the roller wheels and at the same time not so hard as to be dry and brittle. As the bitumen stiffens and hardens, the rolling should be speeded up. Too much rolling can hardly be done at the proper stage of curing. One rolling when the bitumen is in the proper stage of curing is worth several rollings when the bitumen is too soft or too hard. All bituminous mixtures respond most readily to the rolling operation when the bitumen is in the proper stage of curing. The best results are frequently not secured in this class of work because the rolling is not performed at this most desirable time. The proper time to do the major portion of the rolling is governed by the air temperature, sunshine and the grade of bitumen used, as these three factors will control the rate of hardening of the bituminous material.

Alternate Method of Mixing Bituminous Material and Coarse Aggregate After the First Application.—Two distinct methods of manipulation have been followed after the first application of bituminous material. The first

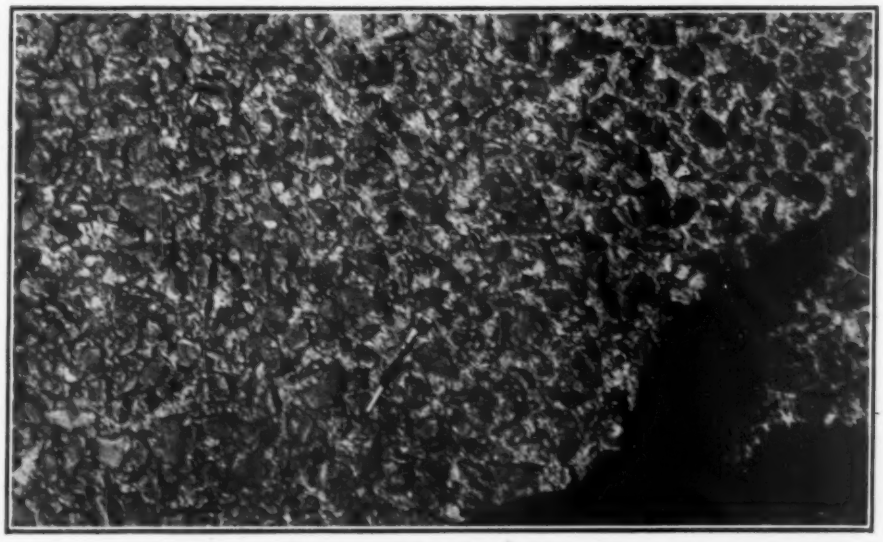


Fig. 10—Close Up View of Bituminous Retread Top Which Will Require Another Treatment Before Going Into the Winter

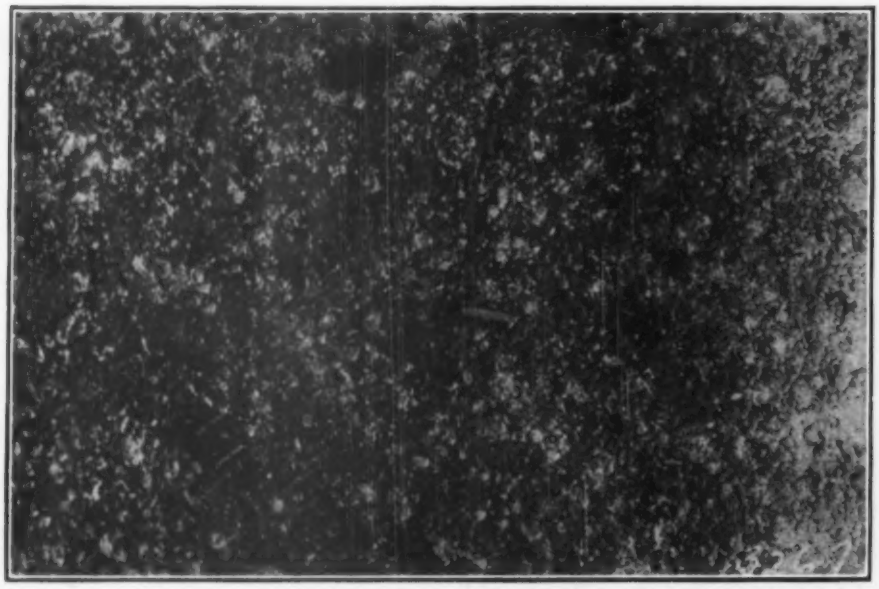


Fig. 11—Close Up View of Finished Retread Top Showing the Voids in the Coarser Aggregate Filled With the Bituminous Coated Covering Stone

method consists in harrowing and blading the coarse aggregate after the first application of bituminous material, so as to thoroughly coat all the stone before rolling. In the second method the harrowing and blading after the first application of bituminous material is omitted.

Condition of Aggregate.—It is extremely desirable that the aggregate be thoroughly dry when the bituminous material is applied. The principal difference between many of the plant mixes and a mix made on the road as described above, is that in the plant mix the aggregate is heated until dry. If the aggregate is thoroughly dry from the warm sunshiny days of summer, the mix made on the road need differ little from the plant mix in so far as the adhesion of the asphalt to the aggregate is concerned. The use of the cut back asphalt also aids in the field mix duplicating the plant mix.

There are many pitfalls which one

Fig. 12—Finished Retread Top Through the Beautiful Hilly Lake District of Northeastern Indiana

may encounter in doing this class of work. As with all bituminous mixtures, it is almost imperative that one practice or experiment in doing this work to some extent, or that he have the advice of a person who has had this experience, if he is to be assured of success. We have had foremen who did an excellent job the first time under the advice of a proper instructor, but upon the second attempt he proved complete failure because of his limited experience and the lack of guidance of a sufficiently experienced man. Outside of the proper leveling of the surface, perhaps the greatest precaution that should be taken is to avoid using too much bituminous material and to use the right amount and grade of covering stone in the finishing process. One should bear in mind that it is always possible to add another coat of bitumen if insufficient has been applied whereupon if at any time too much is applied, it is impossible to remove the excess. The building on the surface of a thick mat of fine aggregate, rich in bitumen, should be avoided as this is liable to result in the "waving and rolling" of the surface in later years which is so characteristic in many bituminous surfaces.

Acknowledgment.—The foregoing is a paper presented at the 8th annual Asphalt Paving Conference, held Oct. 28 to Nov. 1 at West Baden Springs, Ind.

Roadside Planting in Pennsylvania

An inspection of the vines and shrubs planted along the Pennsylvania state highways last spring shows that 85 per cent have withstood the prolonged drought and extreme summer temperature, John W. Keller, Forester of the Pennsylvania Department of Highways, reports. More than 10,000 native honeysuckles, creeping roses, matrimony vines, as well as 50,000 forsythias, barberries, coralberries and other shrubs that were planted last spring are thriving and rapidly covering the slopes on which they are planted. These plants were set out by the highway department to prevent erosion and reduce road maintenance costs.

While the utility value is of first importance, the department is receiving many favorable comments, on its roadside plantings from nature lovers, who believe that any green growth along the roadsides will cover the scars of construction and is to be preferred to bare slopes. These persons visualize roadsides of the future being covered with yellow blooming forsythias, white creeping roses, coral-colored berries and air scented with the fragrance of honeysuckle blossoms.

The roadside planting movement throughout the United States is growing rapidly. Massachusetts has planted 50,000 shade trees during the past 22 years; Indiana has set out 10,000 assorted evergreens; Michigan has planted 140,000 small pine trees; and California has 600 miles of planted highways. In addition to the work that has been accomplished, the State-wide Beautification Club of Florida; Friends of the Native Landscape Association in Wisconsin; and various organizations from garden and civic clubs to chambers of commerce and business men's clubs are encouraging the work.

In Pennsylvvania more than $3,500 worth of plants were purchased this year by interested individuals and organizations and furnished to the Pennsylvania Department of Highways to plant and maintain along the state highways.

Aside from planting and caring for shrubbery on slopes, department employes have the task of caring for natural tree growth and the comparatively small number of trees planted since the department became interested in the work. This growth had been virtually ignored for years by everyone, unless it interfered with overhead service lines or highway operations, when the trees were removed. A small amount of attention to each tree, with necessary pruning and removal of dead limbs, a traffic hazard, has engaged much of the time of the forester's small force. This work is a necessary preliminary and really should have been a routine matter long ago.

Little, of any, care will be necessary to any of the older trees after the "cleaning up" period.

One of the most important tasks undertaken by the men this season was location and study of points where trees and foliage hid scenery. Many of the prettiest "long shots" obtained by motorists were possible only by parking and leaving the car. Removal of dense brush and lower limbs, which is good forest practice at any time, opened these views to the traveler and brought realization that Pennsylvania scenery is second to none. More of this work, and new plantings, is now being scheduled.

Fig. 13—Light Bituminous Retread Constructed to a Width of 4 Ft. on Either Side of the Dunes Highway to Make This Road Safer for the Heavy High Speed Traffic Which It Carries and Which Frequently Turns Out Onto the Road Shoulder Which Was Formerly of Sand

The Model Municipal Traffic Ordinance

A Discussion of Its Various Provisions, Its Acceptance by Municipalities and an Outline of the Present Situation

By C. W. STARK

U. S. Chamber of Commerce, Washington, D. C.; Secretary, Model Ordinance Committee

UNIFORMITY of traffic laws and regulations was declared by the National Conference on Street and Highway Safely from the beginning in 1924, to be one of the prime essentials for street and highway safety. Translation of the principle into tangible rules has been a gradual process.

At the first session of the Conference in December, 1924, a Committee on Traffic Control submitted a list of points on which there should be uniformity, but the Conference felt that such Uniformity could not be accomplished without a pattern and, therfore, a Committee on Uniformity of Laws and Regulations was appointed to develop such a pattern.

This committee, cooperating with the National Conference of Commissioners on Uniform State Laws, worked diligently for upward of a year on the preparation of a Uniform Vehicle Code, and the Conference at its second session in March, 1926, reviewed, revised and approved the code and recommended its adoption by the legislatures of each state.

That committee did not undertake the preparation of a uniform ordinance for municipalities. It expressed the belief that there should be uniformity in ordinances but that they could best be developed by state or regional conferences, and the Conference subscribed to that belief. Several states, notably Michigan and California, had already been at work on such uniform ordinances and in fact they were adopted by numerous cities and towns in the respective states. Comparison of these various models, however, showed wide differences in scope and substance and there grew a feeling that real uniformity was to be obtained only by a nation-wide study. In the summer of 1927, therefore, the chairman of the National Conference on Street and Highway Safety, at the request of several of the participating organizations, of which I believe the National Safety Council was the first, appointed a Committee on Municipal Traffic Ordinances and Regulations.

Uniform Ordinance Essential for Safety.—Even here there was much doubt as to the feasibility of a model ordinance, of developing any set of rules which would fit the wide range of conditions in municipalities of all sizes. The committee soon concluded, however, that on many points uniformity was not only desirable in all communities but essential for safety. For example, if it is objectionable to park within an intersection in New York, it is also objectionable, though possibly less hazardous, to park within an intersection in Jonesville. A red traffic signal should mean the same everywhere.

In its preliminary work the committee decided there were four kinds of provisions to be considered: (a) basic provisions which should be in every ordinance; (b) optional provisions which might be omitted where not needed; (c) state law provisions which might or might not be repeated in the ordinance; should not be in the ordinance. The committee also had an examination made of existing model ordinances and the ordinances in effect in about one hundred principal cities in order to learn the prevailing line of treatment of the various points. While there are in the Model Ordinance certain provisions which may be a step or two in advance of those found in the ordinances then existing, they are not based on snap judgment but upon careful consideration of their desirability and practicability.

Considerable attention was given to this matter of state law provisions repeated in the ordinance. In some states constitutional or enforcement requirements make it necessary to repeat in the local ordinances numerous provisions of the state law. In other states such repetition is unnecessary or even inappropriate. Presented as they are separately in small type, it is quite possible to repeat them or omit them. It may also be noted that some of the provisions of the ordinance proper are elaborations to meet city conditions of basic provisions of the Uniform Act, as for example, the sections relating to pedestrians.

While the Model Ordinance is the subject of this discussion, it may be noted that the principle of uniformity has been developed still further through the work of the American Engineering Council Committee on Signs, Signals and markings. This study was made in close cooperation with the work of the Ordinance Committee, and Engineering Council Committee's report is a manual of recommended practice in these important elements of the traffic control system.

In the Model Ordinance there are perhaps four groups of provisions likely to provoke more discussion than the others. These are those relating to the color and meaning of signs, the relations of pedestrian and motorist, the method of making left turns and the parking provisions.

Color and Meaning of Traffic Signals.—The Ordinance Committee and the American Engineering Council Committee at the outset encountered two outstanding schools of thought in the matter of color and meaning of traffic signals, with variations of each and other less popular proposals. The two schools were those favoring three colors for signals and those favoring only two. Both had strong advocates, but the committees found the support for the three-color system unmistakably much more widespread than that for the two-color system. It was further felt that the two-color system had at least one outstanding objection in that it often calls upon the motorist to do the impossible; that is, stop instantly on appearance of the red just as he reaches an intersection, and in order not to make this unintentional offender a law breaker the system compromises the meaning of the red light. The Ordinance Committee, therefore, recommended definitely in favor of the three-color system and prescribed positive meanings for each of the three colors, the yellow not to be used after red. In recognition, however, of the use of two colors only in a number of cities, the ordinance contains alternate provisions defining the meanings of those two colors under such circumstances.

The details of height, location and method of support of signals, length of cycle, etc., are left to the American Engineering Council Committee, which makes definite recommendations on these points, as on the highly important matter of relation of one intersection to another. The text accompanying the Model Ordinance, however, discusses some of the considerations to be taken into account in these matters.

Rights and Duties of Pedestrians.—An article of four sections is devoted to Pedestrians' Rights and Duties. Before the Ordinance Committee was formed many municipalities had reached the general conclusion that the common law granting of equal rights to pedestrian and motorist in the highway was obsolete and must be replaced by definite provisions both to permit the pedestrian to cross the street in safety under reasonable conditions and to prevent him from blocking traffic by heedless wandering. The earlier ordinances, however, still left considerable doubt on many details, such as what constitutes a crosswalk and who has the right-of-

way when a pedestrian having a "Go" signal encounters a motor vehicle turning on a "Go" signal. The Model Ordinance states clearly that when a pedestrian starts on a "Go" signal he has the right-of-way until he reaches a point of safety regardless of any vehicle operator wishing to turn, and regardless of any change of the signals. This is provided he is on the crosswalk, which is a crosswalk none the less, even if not marked, if it is the prolongation of a sidewalk at an intersection.

Because of widespread differences of opinion as to whether pedestrians should be required to obey traffic signals as religiously as motorists, and because many believe that this is a matter for local determination according to the conditions, the ordinance offers alternate provisions—one that the pedestrian must obey the signals absolutely and the other that he must keep out of the way of motor vehicles obeying the signals.

An important bit of phrasing of these regulations is that the pedestrian or the motorist, as the case may be, must yield the right-of-way. Nowhere does the ordinance say that anybody may take the right-of-way regardless of consequences.

Provisions Regarding Left Turns.—A provision of the ordinance which is provoking much discussion in Washington is that governing left turns. While I know of only three cities which use the so-called rotary method, Washington is one of the three, and to us locally it is a serious question. The Ordinance Committee considered the rotary method and concluded in favor of the standard method of the Uniform Vehicle Code and the Model Ordinance. The situation in Washington seems to illustrate the importance of nation-wide uniformity. Tourists are driving into Washington from every state in the Union, and when Mr. Smith from Detroit and Mr. Johnson from New Orleans try to make the standard turn from the center of the street at the same time my neighbor and I are making a rotary turn, the least that happens is that we block traffic, and there may be a serious collision.

Then there is this difficult question of parking. The Model Ordinance does not attempt to solve the parking problem for any community. That community must determine whether it will prohibit parking in its business section, or establish a one-hour or two-hour limit, or allow unlimited parking; whether it will allow parallel or angle parking, parking on both sides of the street or only one side.

The ordinance does, however, make a definite attempt to classify and evaluate the various uses of the roadway and the relative needs for expediting and safeguarding moving vehicles and pedestrians, affording opportunity for loading and unloading passengers and freight, and permitting vehicles not in immediate use to stand in the street.

When a Vehicle Must Not Stop.—The ordinance declares that there are certain places where a vehicle must not so much as stop unless in obedience to a traffic sign or signal, or to avoid a collision. For example, within an intersection, on a crosswalk, on a sidewalk, between a safety zone and the adjacent curb, where a vehicle, stopped even momentarily, is an obstruction and menace. The ordinance then empowers the traffic authority to set aside certain curb spaces as passenger zones, where vehicles may stop long enough for the actual loading or unloading of passengers; and to set aside other curb spaces where either passengers or freight may be loaded or discharged, but where the vehicle must not be left standing longer than required for these purposes.

Still other spaces may be assigned by the traffic authority to buses, to taxicabs, and to hackneys. These special vehicles do not have exclusive right to these spaces, as private vehicles may stop in them long enough to load or discharge passengers, but only the vehicles to which they are assigned may stand in them indefinitely. On the other hand, these public vehicles, while they may stop in other places to load or discharge, may not park in such places.

The ordinance thus establishes the principle that where a vehicle, even momentarily stopped, will obstruct or endanger traffic it must not stop, and that the need for reasonable loading spaces for passengers and freight, and for the operation of public vehicles, overshadows the need for standing space for private automobiles. It also contains the provision believed appropriate in every community that in the absence of indications to the contrary the only proper place to stop, stand or park a vehicle in the roadway except to meet the exigencies of moving traffic is within 6 in. of the curb.

From this point the ordinance leaves parking prohibitions and restrictions to the local authorities, but offers blank provisions covering complete prohibition in certain places, prohibition during certain hours, parking time limits and prohibition of all-night parking, so that none of these possibilities need be overlooked and any of them deemed desirable can be phrased in what is believed to be understandable as well as legal language.

A Committee on Measures for the Relief of Traffic Congestion has just been appointed by Secretary of Commerce Lamont. It is expected that this committee will grapple with the parking problem and it may arrive at conclusions which will help overcome some of the difficulties which cannot be reached by a uniform ordinance.

The Model Municipal Traffic Ordinance.—The Model Municipal Traffic Ordinance was distributed in final form in August, 1928. A tentative draft was printed and distributed for criticism several months before the committee completed the final draft, and so great was the seeming demand for such an ordinance that several communities revised their ordinances in accordance with the tentative draft, not waiting for the final.

The files of the Conference Secretary show many communities grappling with their ordinances. These include large cities and small cities in the east, west and south. We have not as yet a complete list of those that have adopted the ordinance, because they do not always advise us when they take action, and when word comes to us from one source or another that a certain city has adopted the ordinance we hesitate to list it until we see and compare its ordinance with the Model Ordinance. We are fairly certain, however, that the following cities have entered the fold, besides all cities and towns in New Jersey through incorporation of the Ordinance into state law in 1928, and more recently all cities and towns in Wisconsin by the same process: Providence, Indianapolis, Louisville, Grand Rapids, Port Huron, Findlay, Alton, Savannah, Jackson (Mississippi), Fort Dodge and Great Falls.

The Uniform Vehicle Code has been available three years and the Model Ordinance one year. Thus far we have had little evidence of serious defect in either code. The Ordinance Committee in building the Ordinance around the Uniform Code found it desirable to recommend certain changes in the code. These were changes to amplify or clarify the code provisions rather than to change the principle. For example, the Ordinance Committee, subscribing to the requirements of the code that operators must not pass loading street cars unless the passengers are protected by a safety zone and then only with due caution, felt that the code provision was unduly restrictive in requiring a stop so many feet behind the street car regardless of whether passengers were loading at the rear, front or middle. It found, again, that the through stop provision was being interpreted in some localities in such manner as to deprive cross traffic of reasonable opportunity to proceed after stopping and recommended an additional paragraph to remedy that situation.

While it is believed that both the code and the ordinance have justified confidence in them, it is recognized that each year we know more about traffic and may need to revise our previous views accordingly. The Executive Committee of the Conference has, therefore, recently voted to appoint a special committee to review the code and the ordinance and recommend any changes, additions or subtractions in either.

It is quite possible that one form of change recommended will be transfer of some provisions of the Model Ordinance to the Uniform Vehicle Code. As I have stated, the apprehension of those impressed with the individuality of municipal requirements seems to have

largely disappeared during these last three years. The Conference went as far as it thought proper in 1926 in proposing standardization through state law of provisions affecting municipalities. For example, it agreed that municipalities should be prevented by state law from establishing speed restrictions out of harmony with those elsewhere in the state. When the New Jersey Legislature, in 1928, however, undertook a comprehensive revision of its traffic laws, it was apparently more impressed with the desirability of saving its residents and its many motoring visitors from the harassment of a different set of rules in each town than in according those towns complete home rule in traffic. It thus made a new departure by writing into its law a large part of the Model Ordinance. It even included a large part of the recommendations of the American Engineering Council Committee on Signs, Signals and Markings, although the framers of the Model Ordinance had regarded the details of signs and signals as matters for the judgment of the local traffic authorities. Wisconsin, as I have stated, has done much the same thing this year, and the new committee will probably consider whether this course is to be generally recommended or whether constitutional considerations would prevent it in the majority of states.

Acknowledgment.—The foregoing is a paper presented at the recent 18th annual Safety Congress.

Valuable Subgrade Facts in Public Roads Exhibit

An interesting and extensive exhibit of new developments in subgrade soil research is to be exhibited by the Bureau of Public Roads, U. S. Department of Agriculture, at the Atlantic City Road Show. The exhibit will explain the fundamental principles of the new subgrade soil science and illustrate the practical usefulness of these principles in highway design.

The representative groups of subgrade soils according to their degree of serviceability will be defined and tests indicated for determining the group in which a given soil should be classified. Bureau engineers will be present to demonstrate the tests for soil classification.

While the subject of subgrades is extremely complex because of the number of variables involved, it is surprising how methods have simplified the whole problem so that it may be applied readily by the field engineer. The studies have made possible the systematic classification and correlation of the subgrade data that has heretofore existed in fragmentary and unrelated form.

The exhibit will explain by written text, colored photographs, models and demonstration, such factors as cohesion and internal friction, stability, capillarity, bulking of sands, expansion and shrinkage, permeability, compressibility, elasticity and frost heave.

Simple tests for evaluating these factors will be displayed together with a procedure for examining subgrades in the field and mapping subgrade profiles.

The practical application of the material will be explained in detail by illustrating the type of drainage systems required to overcome certain adverse conditions; when a roller of given weight will provide sufficient compaction; the kind of subbases that are adequate and conditions under which they may be detrimental; the recommended cross-sections of surfacing for the several conditions; together with a wealth of other construction and design data of direct practical application.

Traffic Deaths in Cities Increase

Nineteen of the nation's largest cities will lose from 20 to 40 citizens for every 100,000 population this year from motor vehicle fatalities.

These figures were cited last month in the highway safety campaign of the American Road Builders' Association as indicative of the great need for courtesy and caution on the part of every driver and pedestrain, for all are potential victims of this great evil of modern transportation.

The total of traffic deaths for the first eight months of 1929, which was 8.5 per cent higher than for the same period of 1928, forecasts at least 30,000 deaths and possibly more by the end of the year. The worst months of previous years have been the autumn and early winter months and it is assumed that this year will not be an exception.

Several cities had traffic death increases of 100 per cent or more, comparing the August figures with those of August, 1928. An average of 91 persons were killed each day in August, according to figures of the National Safety Council, which has reports from about one-half the country showing that more people were killed by motor vehicle accidents in the United States in August than in any previous month in our history.

If the proportionate increase by months follows the trend of former years, December, 1929, will see 3,300 deaths—nearly 110 persons daily.

The proportion of pedestrian deaths, which continues to rise, in August was 56 per cent. The opening of school always has brought a higher total figure of pedestrian deaths, as from 40 to 60 per cent are of children under 15 years of age.

The child driver, so commonly blamed for a large share of motor accidents, had a very small part in the accidents reported in August, as, out of 13,000 drivers involved, all but 150 were 18 years of age, or over.

Pittsburgh, Pa., led the list of larger cities, those over a half-million population, which reported in August. Its death rate was 24.8, or approximately 25 persons killed for each 100,000, if the average monthly deaths continue the same for the final four months of 1929. Cleveland, O., was second with a rate of 22.7 Boston is lowest in this group with a probable rate of 14.

In the list of cities between 300,000 and 500,000 population, Cincinnati's approximated death rate is highest, 24.6, and New Orleans is close behind with 23.8. Rochester, N. Y., with a possible 10.4 death rate, is lowest in this group.

Among the cities between 100,000 and 300,000 population, San Diego, Calif., has an approximated rate of 42, and Dayton, O., is next with 32.6. Wilmington, Del., which went on the August honor roll for completing the month without a motor-vehicle death, has only had 3 deaths in the first eight months this year and bids fair to end the year with a death rate of 2.4.

The highest rating in the entire list of reporting cities comes in the class under 100,000 population, which is contrary to the general idea that the greatest traffic danger is in the largest cities.

Atlantic City, N. J., with a death rate that may average 46.2 persons of each 100,000 population this year, heads this group. Chicopee, Mass., is second with 19.3. Low honors of this class go to Shreveport, La., which has been only one traffic death this year, none in August and has an average rate of 1.4, giving it the distinction of being the safest city in the country in which to drive or walk about the streets.

The American Road Builders' Association has consistently fought for wider and safer streets and highways, sane traffic legislation and its strict enforcement, elimination of grade crossings, dangerous curves and other hazards, uniformity of traffic control. It is believed that in addition to all these efforts, the driver and pedestrian must contribute courtesy and caution to the great cause of highway safety.

Mexican National Highway Program Progressing.—According to a recent press report, the program of the Mexican National Highways Commission for the remainder of 1929 and the year 1930 comprises the establishment of at least provisional highway communication between Mexico City and Nuevo Laredo; Mexico City and Guadalajara; Mexico City and Vera Cruz; Mexico City and Oaxaca, in addition to minor projects in other vicinities of Mexico City. According to the latest report which has been made by the National Highways Commission to the Ministry of Communications and Public Works of the Mexican Government concerning work on highways, satisfactory progress has been made on several of the principal highway projects.

The Asphaltic Treatment of Earth Road Surfaces

Methods and Costs of Constructing Oiled Road Surfaces in Fresno County, California, Where 3,000 Miles of This Type Is Now in Service

By CHRIS. P. JENSEN
County Surveyor, Fresno County, California

THE development of what is locally termed "oiled road surfaces" in Fresno County is the result of some 25 years of effort and experience. It had its inception while horse-drawn vehicles still represented 90 per cent of the general traffic, and at a time when the development of the mineral oil fields in Fresno and other counties of the state of California had reached considerable proportions. The observation of the effects of traffic over stretches of road upon which oil had been spilled or distributed, near oil well operatons, was responsible for the initial use of oil on road surfaces, and the beilef that such a procedure would be a very economical and efficient method of preventing the customary dust nuisance as well as provide a smoother and more firm surface for traffic.

While the first applications of road oil were restricted naturally to the more important thoroughfares running through the county, the comfort, convenience and economy of such a treatment, caused an ever-increasing demand for the extension of the use of road oil to roads other than the main thoroughfares. The governing body of the county therefore continued to increase the mileage of oiled roads from year to year, and at the present time the county has to its credit approximately 3,000 miles of oiled road surfaces, constructed and maintained at no greater cost than would have been the cost of maintaining an ordinary earth surface from year to year. During the last eight years, the annual purchase of oil by the county, for road oiling purposes, has reached a total of approximately 150,000 bbl. of 42 gal. each.

Fig. 2—Roadway Which It Had Been Found Necessary to Scarify to a Depth of 6 In. in Order to Properly Eliminate Chuckholes, and Which Is Ready to Receive Its Distribution of Oil

Soil Conditions.—Fresno County has a wide variety of soil conditions, including pure sand, sandy loam, red loam, alluvial, adobe, dry bog and soils impregnated with what is commonly designated as black alkali, and white alkali. Naturally the oiling operations must be varied and adapted to each individual soil condition. By a proper analysis of all soil conditions, coupled with the results of accumulating experiences, the oil treatment has been eminently successful on all soils, with the possible exception of soils impregnated with white alkali. Alkali soils present a problem beyond the influence of anything other than extremely heroic treatment, including the stabilizing of the subgrade for a considerable depth by the importation of rock. This soil is of such a vicious character that even heavily reinforced concrete road surfaces are not immune from its destructive effects.

On adobe or dry bog soils, the efficiency of the oiling operation is materially enhanced by the use of sand or small river gravel applied to a depth of from 4 to 12 in., according to conditions of subgrade saturation. On all other soils, the application of oil is made without the assistance of any other stabilizing or reinforcing materials.

Generally speaking, the road surfaces in Fresno County, treated with road oil, will carry a mixed traffic of 1,500 vehicles per day. The maximum load limit on any vehicle in California is 22,000 lb. on four wheels, or 34,000 lb. on six or more wheels.

As already indicated, certain soils, particularly if subject to excessive moisture, or not well drained, have not sufficient stability to support this traffic

Fig. 1—Roadway After a Light Scarifying Preparatory to Receiving a Distribution of Oil

Fig. 3—Oil Truck Spreading Oil

without the use of other materials such as sand, gravel, or crushed rock in sufficient quantities to overcome the instability of the foundation and to support the oiled earth surfacing and its superimposed traffic.

Road Oil Specifications.—Until 1921, the oil used for road purposes was a natural crude oil, as taken from the wells, and without any distillation or refinement; a selection of the oil to be used was usually made from wells discharging oil of approximately 14 deg. gravity, Baume scale, carrying 65 per cent of bitumen or asphalt. During the last few years a refinery residue has been specified, carrying an asphaltic content of 65 to 73 per cent. The results obtained have been practically identical in the use of either of the above mentioned oil products, but at the present time we are inclined to the use of a road oil carrying not more than 65 per cent of bitumen, for the reason that if the heavier oil is used, and after two or three years of such applications, the road surface becomes so hard and tenacious as to render the surface not readily susceptible to scarification and smoothing.

The oil is delivered in railroad tank cars, and before being applied, must be heated to a temperature of approximately 200° F. For this purpose the county employs the use of 20-hp. boilers with sufficient retorts to bring the oil to the required temperature. These heating plants are made portable so as to be readily taken to any delivery point on the railroads. For use within a radius of ten miles of Fresno City, the county has a fully equipped and standard steam heating plant with a reservoir capacity of five railroad tank cars. At the present time the cost of oil at the well is 52½ ct. per barrel of 42 gal. Freight charges bring the total cost of the oil at various delivery points in Fresno County to $1 per barrel.

Road Oiling Methods.—The making of a satisfactory oiled road surface is a matter of gradual development. Unless exceptionally favorable conditions prevail, a satisfactory surface cannot be obtained until the second year, or until four or five applications of oil have been made. Each application of oil is made at the rate of approximately ¾ gal. per square yard of surface, varying slightly according to soil conditions. In new road construction, two, or even three, applications of road oil can be applied during one year; in order to take advantage of weather conditions, the county restricts its oiling season to the months of June, July, August and September. Operations during the winter months do not prove to be as economical nor do they produce as favorable results as operations undertaken during the summer months.

The first requisite in new road construction, as in other methods of construction, is to bring the road to its proper crown, grade and alignment. In Fresno County, except in mountainous districts, the grading of a road is a very simple matter, the only implements required being a tractor and grader of sufficient power for its purpose; usually a "60" caterpillar and 10 or 12-ft. blade is used. After the road has been brought to its proper grade and cross-section, a small amount of the earth is bladed to the edges of the portion to be oiled. Oil is then spread over the surface of the roadway at the rate of approximately ¾ gal. per square yard, and immediately covered with the earth previously bladed to the edges; this covering is done by means of power graders, or by caterpillar-drawn graders. The influence of the summer heat tends to draw the oil upward, and particularly so when traffic is given access to the roadway, so that after a few days under traffic, the oil gradually works to the surface, giving the road surface a smooth, black appearance, similar to the surface of an asphalt pavement. Should it appear that there was not sufficient covering spread over the oil to prevent free oil coming to the surface, additional covering material is bladed in from the shoulders or borrow pits. Any excess of covering material will be rapidly thrown aside by moving vehicles.

As soon as the traffic begins to break through the first application of oil, the surface is scarified and pulverized to a depth of 2 or 3 in., and a second application of oil, at the same rate, is then applied in similar manner to the first application. This procedure would be repeated from time to time during the first two years, until the entire roadway has assumed a proper condition of stability. Under ordinary conditions of soil, four or five applications will be found sufficient.

It has not been found necessary to make use of a roller in any of these operations, it being a peculiarity of oiled earth surfaces that the solidfication of the surface material is effected more rapidly and perhaps more efficiently by

Fig. 4—Covering the Oil by the Use of One-Man Power Graders

Fig. 5—Roadway One Year Old Which Has Just Been Scarified Lightly, and Which Will Receive No Further Oil Treatment at This Time

traffic than under the action of a roller. During the first two or three months after the application of oil, the volatile oils gradually evaporate, and coincidentally, the surface becomes gradually solidified or hardened. During this period of solidification it may be necessary to occasionally scratch and plane the surface with a scarifier and grader in order that when final solidification takes place in the early winter temperature, the surface may be true to cross-section throughout the winter season. It scarcely ever becomes necessary to do any maintenance work on oiled surfaces during the winter and spring months.

Oil is distributed from tank wagons of a capacity of approximately 1,200 gal., by a gravity flow, through perforated distributor pipes covering a width of 10 ft. of roadway in one application. The oil should have a temperature of not less than 200° F. for proper distribution. Oil distribution from tank distributors equipped with power sprays, has been used, but the additional advantages derived from distribution from power sprays have not been sufficient to warrant their use.

Costs.—The total cost of applying the oil, resolved into a gallon unit cost, including preliminary blading, spreading, covering and subsequent scarifying and planing, but not including the original construction of the foundation grade, will average 3 ct. per gallon for each application. One mile of roadway treated with oil to a width of 10 ft. would therefore cost $132 for each application; assuming that the roadway would be brought to a stabilized condition in four applications of the oil, we would have a total cost of $528 per mile, which would represent what might properly be termed the end of the construction period, and the commencement of what might properly be termed the maintenance period.

Maintenance.—During the first three or four years of service, a newly constructed oiled road is carefully watched, and special localized treatments are given according to weaknesses and peculiarities developing during the process of stabilization and evaporation of volatile oils. No predetermined or uniform treatment of maintenance work can be specified, due to the lack of uniformity in soil characteristics and drainage conditions. Unlike a uniformly constructed surface involving the use of rock aggregates in proper proportions, and binders, the non-uniformity of the earth structure permits the oil surface to shift, and sometimes to take on a corduroy or wavy surface. Correction of this peculiarity is made by the use of a scarifier and blade from time to time as may be found necessary.

After a road has been constructed for a number of years, and becomes stabilized under the action of traffic, the oil will not generally need to be renewed oftener than once ever two years.

In the spring months the road superintendents make a complete survey of the oiled surfaces, and a program of maintenance is outlined for each road effective during the summer and autumn months. In some cases it will be determined that the road will need nothing further than a planing of the surface; in other cases, it will be determined that a single application of oil should be used; and in still other cases, where the traffic has been heavy, or soil and subgrade conditions unstable, it will be determined that the road should receive a complete scarification and re-oiling.

Where only a planing of the surface is deemed necessary, the road is given a light scarifying and blading one or more times during the eight months surrounding the summer season, as may be required by conditions. The material which is loosened by this operation is uniformly spread over the surface by the grader, and is immediately compacted and united with the old surface under the action of traffic.

When it is determined that the oil cake has become so old as to have lost its resiliency, and another application of oil is desirable to renew the life of the surface, the roadway is scarified to a depth of approximately 1 in., the loose material is bladed to the edges of the roadway, an application of oil, at the rate of from ⅛ to ¾ gal. per square yard, according to conditions, is distributed over the surface, after which the loose material previously bladed to the edges is bladed back over the fresh oil, and the road immediately thrown open to traffic.

Should it be determined that a roadway has become so badly rutted as to

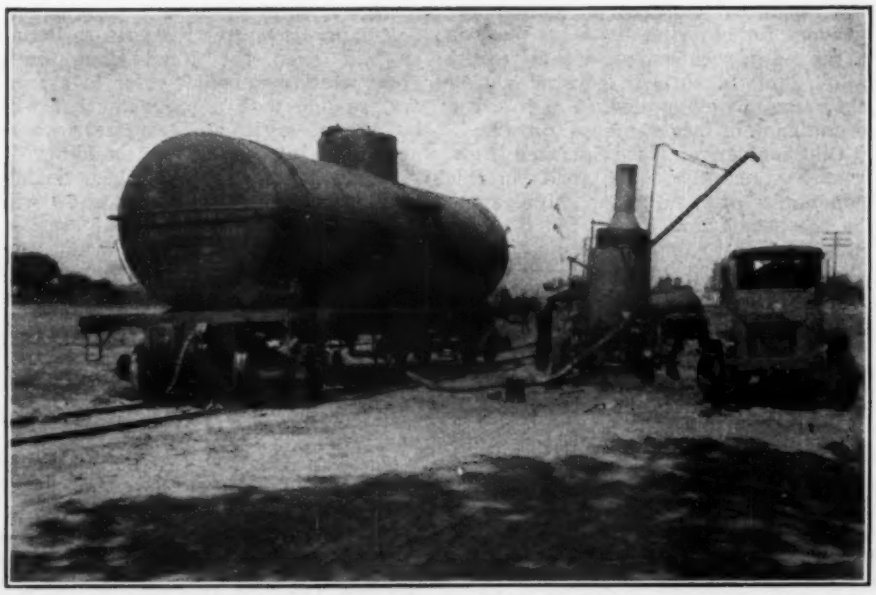


Fig. 6—One of the County's Oil Heaters, Used for Heating the Oil in Railroad Tank Cars, Preparatory to Distribution Along the Road

Fig. 7—Effect of Oiling the Shoulders Adjacent to a Hard Surfaced Pavement

render correction by the two former methods impracticable, the roadway is scarified to the depth of the chuckholes, and all the loose scarified material thoroughly pulverized. A portion of the upper surface is then bladed to the edges of the roadway, for subsequent use as cover material, oil is spread over the surface at the rate of ¾ gal. per square yard, and the earth previously bladed to the edges is bladed back over the freshly oiled surface.

The cost of the operations described above will range from $50 per mile in the case of a simple scarification and planing, to a maximum of $200 per mile in the case of a roadway which has to be completely pulverized and rebuilt.

The usual maintenance equipment employed in Fresno County consists of 60-hp. caterpillars, Haynes improved road machines (which scarify, pulverize and blade the material practically in one operation), gravity oil tank spreaders mounted on trucks, and power graders for covering the oil. Work is arranged in such a manner that freshly applied oil is entirely covered during the same day as applied, so as to cause a minimum of inconvenience to traffic.

Oil Shoulders on Hard Surfaced Highway System.—The oiled roads in this community are held in such high repute by the people that it was found advisable to apply our oiling methods to shoulders of the bonded highway system. This work is done in similar manner as described for the ordinary roads, and at a similar unit cost.

The result of such treatment on the highway system is in effect the equivalent of widening the highway itself, as under the present standard of maintenance, the line of demarcation between hard surfaced pavement itself and the oil shoulders, is scarcely discernible. The shoulders are usually oiled to a width of 5 ft.

Acknowledgment.—The above paper was presented at the 8th annual Asphalt Paving Conference.

The Progress on Convention and Road Show

The preliminary program for business sessions and entertainment of delegates to the American Road Builders' Association convention and road show at Atlantic City, Jan. 11 to 18, offer something of interest for everyone in the United States in any way connected with road building.

From the time when distributors and manufacturers have their preview of the show on Saturday, Jan. 11, until the final business and executive committee meetings end on Friday, Jan. 18, there won't be a dull minute, the program reveals.

Sunday, the entertainment program will get under way with a reception and tea in honor of Pan American diplomats, many of whom are going up from Washington, the Pan American delegations and distinguished visitors from foreign countries.

Monday, President Frederic A. Reimer will open the Road Show with appropriate ceremonies prior to a general session with a program that will be attractive to all delegates, whatever their interest in road building.

Registration will take place during the forenoon, also. The road show will be closed during the general session, Monday, and again on Wednesday morning.

A luncheon Monday noon will be followed by organization of a Pan American finance committee. In the afternoon sessions for city officials, county highway officials, contractors and the lien law committee will get under way.

The Pan American division will meet late Monday at Pan American headquarters in the Ambassador Hotel.

The committees on subgrades and pavement bases, municipal airports and grading will meet Tuesday morning and the city, county and contractors' groups will meet again Tuesday afternoon.

The Pan American delegates will officially visit the Road Show Tuesday morning.

Wednesday morning and afternoon the general sessions will mark Pan American day, with speakers from most of the Latin nations, who will tell of road building progress. The city and county groups and the new location committee will meet separately in the afternoon.

A luncheon is scheduled for Wednesday noon, to which the guests will be professors of engineering from many of the leading universities and technical schools, and this group will organize an educator's section or committee which should be of great value to the educational purposes of the Association.

The popular equipment and finance committees will assemble Thursday morning, with national authorities on both subjects presenting papers of intense interest and value, followed by general discussion of the committee problems.

State and county highway officials will meet at luncheon Thursday. The city and county divisions and the grade crossings committee will meet in the afternoon.

Dr. Hernan Velarde, Ambassador E. and P. of Peru to the United States, and Senor Don Orestes Ferrara, Ambassador E. and P. of Cuba, will be among the international celebrities who will be guests of the Association at the mammoth Road Builders' banquet on Wednesday night and the International Ball, Thursday night. Other entertainment will be arranged for their pleasure during their stay in Atlantic City. Many Federal Government officials will be in company of honored guests.

Travel in National Parks Breaks All Records

A normal increase in travel to the national parks and monuments administered by the Department of the Interior is reported for the 1929 travel year, which closed Sept. 30. The total of 3,248,264 is 223,420 above the 1928 figures, and is the highest yet recorded.

Visitors to the national parks alone during 1929 totaled 2,680,597, as against 2,522,188 in 1928. The travel to the national monuments totaled 567,667 in 1929, and 502,656 in 1928.

Eleven, or more than half of the national parks, passed the hundred thousand mark this year, Hawaii Park for the first time. Substantial increases in travel also were shown in Yellowstone, Sequoia, Crater Lake, Glacier, Rocky Mountain, and Grand Canyon National Parks. The new national parks, Bryce Canyon and Grand Teton, had, respectively, 21,997 and 51,500 visitors. The principal increases in national monument travel were at Carlsbad Cave, Capulin Mountain, Casa Grande, Devils Tower, Papago Saguaro, Pipe Springs, and Scotts Bluff.

Types and Characteristics of Emulsions for Asphalt Paving Purposes

Definitions and Types of Emulsions — Emulsions as Related to the Paving Industry — Mechanical Technique of Preparation—Specific Properties of Emulsions for Paving Purposes

By LESTER KIRSCHBRAUN

Vice-President in Charge of Research, Flintkote Company, New York, N. Y.

THE petroleum and asphalt industry have long been in close contact with that system of colloidal chemistry known as an emulsion.

Definition of Emulsion.—For our purposes we may define an emulsion as a heterogeneous system containing two normally immiscible liquid phases, one of which is dispersed as fine droplets or globules in the other. The inner phase or the liquid which is broken up into the fine droplets is known as the dispersed phase, and the other liquid throughout which the droplets are distributed is known as the continuous phase.

In dealing with dispersions in which one of the phases is asphalt, we can consider asphalt as a liquid of high viscosity, even though common parlance and arbitrary standards set up in the industry segregate asphalts according to hardness, as solid, semi-solid and liquid. The term emulsion is therefore used with asphalt in this broad sense.

Types of Emulsions.—With any two liquids as oil and water there are two types of emulsion possible. When water is the continuous phase, the emulsion is called the oil-in-water type. When oil is the continuous phase and water is distributed throughout the oil, the emulsion is termed the water-in-oil type.

Industrially, both types of emulsion are important. They may be found in nature or prepared artificially. Oil field emulsion, lubricating grease, and butter, are water-in-oil emulsions. Milk and cod liver oil exemplify naturally occurring and artificially prepared oil-in-water emulsions, respectively.

Temporary Emulsions.—When to relatively larger amount of water there is slowly added with vigorous agitation a smaller amount of benzine, the drops of benzine appear dispersed throughout the water. This produces a two-phase emulsion which exists only temporarily, and when agitation ceases, the two layers separate completely and almost immediately.

Permanent Emulsions.—To produce a more permanent emulsion, a third agent must be added to the two phases above described. These agents are generally colloids which are capable of being absorbed at the interfacial layers between the phases. By forming a protective film about the dispersed phase, the drops are thus prevented from coalescing after dispersion has occurred. Permanent emulsions are all three-phase systems in which the emulsifying agent in the presence of the two liquid phases, functions to facilitate the formation of the emulsion, and to preserve it when formed against immediate coalescence of the dispersed phase. The emulsifying agent in fact forms an absorbed protective film about the dispersed particles, and it is upon the nature of this film that the properties and usefulness of the emulsion largely depend.

Types of Emulsifying Agents and Resulting Emulsions.—The emulsifying agents which may be employed in producing emulsions are generally of two types, although the distinction between these types is not very sharp in certain cases. We may group these substances as follows:

(a) Substances which lower the surface tension of one of the phases.

(b) Substances which affect the surface tension of the contained medium slightly, but which swell in contact with the medium in which it is peptized, and in relatively small concentration produce a plastic or viscous suspension.

As stated before, either type of emulsifying agent must be capable of being absorbed at the interface and must be capable of being "wet" by one or by both of the phases present.

Soaps, sulphonated oils and saponaceous materials are typical of group (a), while starch, casein and certain colloidal oxides and clay-like minerals exemplify group (b).

Emulsifying agents of both groups may produce either water-in-oil or oil-in-water emulsions, depending, among other considerations, upon their individual chemical and physical properties, the concentration of phases and the manipulative condition under which the emulsion is formed. Thus an oil-in-water emulsion is obtained when agents of group (a) are employed, which are soluble in and lower the surface tension of the water more than that of the oil. Sodium oleate therefore tends to produce an oil-in-water emulsion, while soaps of the polyvalent metals such as copper or magnesium oleate, which are soluble in, and/or primarily wet with oil, will ordinarily produce a water-in-oil emulsion.

Those agents of group (b) which are wet by either phase, may likewise produce either type of emulsion, depending among other factors, upon the concentration of the phases at the time of formation. By having all of the oil phase present and by introducing the aqueous phase in small increments, a water-in-oil emulsion will result, while if the reverse manipulation is carried out an oil-and-water emulsion is found. Thus it is sometimes possible for both types of emulsion to exist, of identical composition.

Properties of Oil-in-Water Emulsions.—Limiting our discussion for the moment to only asphalt-in-water types of emulsion, it may be observed that, from the emulsifying agents classified above, there result emulsions of two general types:

1. Emulsions which coalesce prior to dehydration.
2. Emulsions which must dehydrate prior to coalescence.

The first type of emulsion generally "sets" or breaks more readily than the second. It is very sensitive to the introduction of foreign substances, particularly to electrolytes which precipitate the emulsifying agent, and to admixtures with mineral powders, or to any change brought about in the nature of the electric charge upon the particles.

The second type of emulsion generally "sets" more slowly than the first. It is more stable than the first and will permit incorporation of a greater or less variety of electrolytes and of substances of other types, depending upon the specific agent used.

The great variation in properties of the above two types of asphalt-in-water emulsions, lends itself to widely different fields of industrial uses.

Role of Research in Perfecting Asphalt Emulsions.—It does not seem necessary in this paper to discuss further theories of emulsification. Suffice it to say that in the last decade or two the science of colloid chemistry has made great advances in the study of, and in the understanding of emulsions.

Knowledge thus developed of various properties and behaviors which may be imparted to, or brought about in emulsion systems, is opening an ever widening field of research and application in industry. Technically and commercially great progress has been made, so that the preparation, modification and uses of emulsified asphalt in various branches of industry, including paving, is becoming of increasing importance.

Emulsion as Related to the Paving Industry.—In the paving industry we are concerned primarily with oil-in-water emulsions. Specifically we will discuss permanent emulsions in which asphalt of suitable consistency or penetration, may be used in an aqueous medium as a road binder or cement. In connection with this industry we may further limit our field of inquiry to that type which coalesces without complete dehydration or "sets" comparatively quickly.

This type of emulsion is generally prepared with the aid of emulsifying agents which are included in type (a) previously described. Specifically they may be mono-valent soaps of the higher fatty acids, resin soap, or soaps of sulphonated oils. In some cases the asphalts themselves contain acid constituents (probably naphthenic acids) which require only the addition of suitable concentrations of alkali in the aqueous phase to effect emulsification. The latter emulsions, however, are seldom sufficiently permanent for transportation and storage, and require the subsequent addition of protective colloids or extraneously prepared emulsifying agents for their further stabilization.

Mechanical Technique of Preparation.—Inasmuch as this type of emulsion is made with an agent which functions to lower the surface tension of the water phase considerably, the preparation from a mechanical standpoint is relatively simple. This involves vigorous mechanical agitation, while the phases are both freely liquid. This may be provided by means of paddle mixers, centrifugal pumps and similar agitating devices. A more recent development in preparation technique, involves the use of the colloid mills of various types. This type of mill with rotating discs operating at exceedingly high peripheral velocity, develops a shearing effect within the liquid film that effectively and rapidly produces dispersion.

While the preparation of an emulsion is relatively simple from a broad viewpoint, great variation in properties and in usefulness will result even in using the same emulsifying agent. Many factors influence the product in this direction, among which may be mentioned temperature, concentration of phases with respect to each other, character of asphalt employed, presence of specific ions, concentration of such ions and the nature of mechanical action to which the system is subjected. All of these, as well as other factors, influence the properties of the end product and must be understood and controlled in order to produce an emulsion of uniformity and of predetermined characteristics. It is a rather anomalous situation that the same apparatus which will make an emulsion will frequently also break it.

Improvement in Manufacturing and Application Technique.—It might be well to point out here that emulsified asphalts have been used continuously in the United States for as long as 15 to 20 years. Pavements laid in the early days frequently gave exceedingly good results, but more often possibly, the results were erratic and uncertain. As with many other paving materials, such results merely serve to indicate lack of control in preparation of the material or unsatisfactory technique of use and application. Through the development and application of colloid chemistry to this art, it is believed that the former difficulties have been definitely overcome. Likewise, paving engineers have perfected application technique to a point at which it is believed that a wide usefulness for asphalt emulsion in the paving field is about to be realized in the United States.

Specific Properties of Emulsions for Paving Purposes.—Reverting again to our discussion of theories of emulsification, it is apparent that the properties of an emulsion useful for paving purposes, will depend largely upon the nature of the film protecting the dispersed particles. Workers in the field, by applying principles discussed above, have developed and controlled properties of these emulsions to adapt them to specific uses. It may be well, however, to enumerate some of the characteristics necessary for a successful paving emulsion.

1. It should contain asphalt of penetration, ductility, cementing value and other characteristics normally suited to the type of use contemplated.
2. It must have bulk stability. That is, it must not be broken down upon long periods of storage, or upon agitation during transportation.
3. It must have sufficiently fine particle size so as to be freely suspendable.
4. It must have a controlled degree of stability as a system, so that it will not break prematurely when sprayed or when mixed with mineral aggregates, inert mineral powders or with diluting water.
5. Its time of coalescence or "rate of break" must be suitable to the conditions for which it is to be used. In other words it should break when deposited upon the road in the shortest time compatible with its other stability requirements.
6. Its viscosity must be definite, constant and suited for the purpose for which it is to be employed.
7. It must have a concentration of asphalt which does not vary for the particular use for which it is intended.
8. The relation between asphalt concentration and viscosity should be such that a regulated and predetermined film thickness is always deposited.
9. The concentration of the emulsifying agent should be a minimum and always less than that which would in any way modify the properties of the asphalt binder.

Asphalt emulsions are now being manufactured both in the United States and abroad in which the above enumerated characteristics are controlled and adapted for certain specific construction types.

Successful Use of Asphalt Emulsion for Paving Purposes.—European engineers have developed a road construction technique which, coordinated with the production of emulsified asphalt adapted thereto, has resulted in the building of tremendous mileage of roads. The types of application generally employed comprise the carpet coating of gravel and macadam roads and the building up of new wearing surfaces by the so-called grouting method. This is generally similar to our penetration construction with hot application. This development in Europe has been stimulated probably largely through (1) existence of already completed macadam roads useful for foundation purposes. (2) Low initial cost of construction. (3) Small investment in equipment. (4) Ease of application with unskilled labor. (5) Ability to carry on construction in wet weather. (6) Low cost of maintenance.

In addition there is being developed a widespread use of emulsified asphalt in connection with the curing of concrete roads. This treatment lends itself to many obvious advantages and may well bring about important advances in the surface treatment and maintenance of this type of construction.

There is no doubt that in this country an extended use of emulsified asphalt is coming about in connection with our secondary roads. Paving engineers are developing familiarity with this type of material. For certain classes of roads, including maintenance and new construction, emulsified asphalt is now finding an increasingly important place in America.

Acknowledgment.—The above is a paper presented Oct. 30 at a meeting of the Association of Asphalt Paving Technologists, West Baden Springs, Ind.

Proposed Increase in Gasoline Tax in British Columbia to Finance Road Construction.—The gradually increasing support that is said to be developing among boards of trade and other organizations for an increase to 5 ct. per gallon in the tax on gasoline, is expected to result in the introduction of legislation for that purpose at the winter session of the British Columbia Assembly. The present tax of 3 ct. is said to yield approximately $950,000 yearly, and indications are that the yield will exceed $1,000,000 this year. This revenue, with that derived from motor vehicle licenses, will provide a fund of $2,500,000 in 1929, which may be devoted to carrying loans for road building. The existing carrying charge on outstanding road loans amounts to $1,916,320, it is said, which will leave about $633,600 to cover additional loans amounting to $7,000,000 to be devoted to highway construction.

Rock Asphalt Top on Concrete Base

Construction Methods and Equipment Used in Surfacing a 19-Mile Stretch of Road in Putnam County, Tennessee

By H. R. McGUIRE

NELSON BROS., contractors, of Memphis, Tenn., have recently completed for the State Highway Department of Tennessee a very important project in Putnam County.

It consists of a 19-mile stretch of 1½-in. rock asphalt wearing surface laid on a 7-5-7-in. (double parabolic curve) concrete base.

In one 5-mile section of the project 26 curves were widened, as the road passes through an extremely mountainous section of the country.

A standard concrete finishing machine running on the integral curbs with a rotating rake attachment was used in laying the rock asphalt surface. First, the concrete base, which was left with a rough and granular surface, was thoroughly swept, removing all foreign material. Then, a uniform paint coat

(1) Spraying Paint Coat. (2) Unloading and Spreading Rock Asphalt. (3) Front View of Finishing Machine. (4) Rear View of Finishing Machine, Showing 10-Ft. Lute. (5) Rolling Rock Asphalt Surface. (6) Finished Surface

of asphaltic cement thinned with high grade gasoline to the consistency of very thin house paint, was applied with a pressure pump equipped with a spray nozzle attachment.

Rock asphalt was dumped on the surface from trucks and roughly spread by hand in front of the finishing machine. Due to the fact that curves were widened it was necessary to lay an additional track for the machine at these points, the extra space being laid by hand with the use of rakes in the usual manner.

The rotating rake attachment on the finishing machine broke up all lumpy material so that after the first screed passed over it the surface was fairly free of voids. Any remaining voids were filled by using a little screened material and sifting it in front of the back screed.

The surface was straight-edged immediately following the machine and then rolled with a 6-ton tandem roller.

The rock asphalt (Kyrock) used as surfacing material was furnished by the Kentucky Rock Asphalt Co., of Louisville, Ky.

Uniform Traffic Rules

New Code for Massachusetts State Highways

NEW uniform traffic rules and regulations for the operation of all horse drawn and motor vehicles on the state highways of Massachusetts went into effect on Oct. 26. The complete text of these rules follows:

In accordance with the provisions of section 3, chapter 357, acts of 1928, and after due notice and hearing, the following rules and regulations respecting the operation of vehicles, which for the purpose of these rules and regulations shall mean all horse drawn vehicles and all motor vehicles as defined in chapter 90 of the general laws, upon highways, which for the purpose of these rules and regulations shall mean all state highways and all through ways, designated as such by the department, are hereby adopted by the department of public works.

Section 1. (Drive on right side of highway.) (a) Upon all highways, except one-way streets, the driver of a vehicle shall drive the same upon the right half of the highway and shall drive a truck, bus horse drawn or slow moving vehicle as closely as practicable to the right-hand edge or curb of such highway, except when overtaking and passing another vehicle, or when placing a vehicle in a position to make a left turn.

(b) When any highway has been divided into lanes a driver of a vehicle shall drive in the same so as to be entirely within a single lane and shall not move from the lane in which he is driving until he has first ascertained if such movement can be made with safety; further provided that the driver of a vehicle shall operate the same in the lane nearest the right side of the highway when said lane is available or in preparation for a left turn, and upon any highway which is divided into three lanes no driver of a vehicle shall operate the same in the center lane unless overtaking another vehicle or in preparation for a left turn, or unless the right lane is impassable, or unless, told to do so by a police officer.

Section 2. (Keep to the right in crossing intersections or railroads.) In crossing or upon approaching an intersection of highways or the intersection of a highway by a railroad right of way, the driver of a vehicle shall at all times cause such vehicle to travel on the right half of the highway, unless such right half is impassable.

Section 3. (Limitations on privilege of overtaking and passing.) (a) The driver of any vehicle overtaking another vehicle proceeding in the same direction shall pass at a safe distance to the left thereof.

(b) The driver of an overtaking motor vehicle not within a business or residential district shall give audible warning with his horn or other warning device before passing or attempting to pass a vehicle proceeding in the same direction.

(c) The driver of a vehicle shall not drive to the left side of the center of a highway in overtaking and passing another vehicle proceeding in the same direction unless such left side is clearly visible and is free of oncoming traffic for a distance ahead to permit such overtaking and passing to be made as provided in clause (d).

(d) The driver of a vehicle shall not overtake and pass another vehicle proceeding in the same direction unless there is space ahead on the right side of the highway to permit the overtaking to be complete without impeding the safe operation of any vehicle ahead, or without causing the driver of any such vehicle to change his speed of movement or alter his course except as provided in Section 4 thereof.

(e) The driver of a vehicle shall not overtake and pass another vehicle proceeding in the same direction upon any hill or any curve in the highway where the driver's view along the highway is obstructed within a distance of three hundred feet unless the highway is divided into four or more lanes and the overtaking and passing can be completed without driving to the left of the center of said highway, and further provided that the driver of a vehicle shall not overtake and pass another vehicle at any place where official highway signs have been erected prohibiting such passing.

(f) The driver of a vehicle shall not overtake and pass any vehicle proceeding in the same direction at any steam or electric railway grade crossing, unless permitted to do so by a police officer.

Section 4. (Driver to give way to overtaking vehicles.) The driver of a vehicle when about to be overtaken and passed by another vehicle approaching from the rear shall give way to the right when practicable in favor of the overtaking vehicle, on suitable and audible signal being given by the driver of the overtaking vehicle, and shall not increase the speed of his vehicle until completely passed by the overtaking vehicle.

Section 5. (Following too closely.) (a) The driver of a motor vehicle shall not follow another vehicle more closely than is reasonable and prudent, having due regard to the speed of such vehicles and the traffic upon and condition of the highway.

(b) The driver of any motor truck, bus, or horse-drawn vehicle when traveling outside of a business or residential district shall not follow another such vehicle within 200 feet, but this shall not be construed to prevent a faster moving motor truck, bus, or horse-drawn vehicle overtaking and passing another vehicle.

Section 6. (Turning at intersection.) The driver of a vehicle intending to turn to the right at the intersection shall approach such intersection in the lane for traffic nearest to the right side of the highway, and in turning shall keep as closely as practicable to the right curb or edge of the highway, and when intending to turn to the left shall approach and enter such intersection in the lane for traffic to the right of and nearest to the center line of the highway, and at the point of leaving shall drive said vehicle to the right of the center line of the highway being entered.

Section 7. (Signals on starting, stopping and turning.) (a) The driver of any vehicle before starting, stopping or turning from a direct line shall first see that such movement can be made in safety and if any pedestrian may be affected by such a movement shall give a clearly audible signal by sounding the horn, and whenever the operation of any other vehicle may be affected by such a movement shall give a signal as required in this section plainly visible to the driver of such other vehicle of the intention to make such movement.

(b) The signal herein required shall be given a sufficient time in advance of the movement indicated to give ample warning to any person who may be affected by said movement, and shall be given either by means of the hand and arm in the manner herein specified, or by a suitable mechanical electrical device, except that when a vehicle is so constructed or loaded as to prevent the hand and arm signal from being made or being visible both to the front and rear the signal shall be given by a suitable device.

(c) Hand and arm signals as required herein shall be made as follows:

(1) An intention to stop shall be indicated by extending the arm horizontally to the left of, and beyond the side of the vehicle.

(2) An intention to turn to the left shall be indicated by extending the arm horizontally to the left of and beyond the side of the vehicle, and by pointing to the left with the index finger.

(3) An intention to turn to the right shall be indicated by extending the arm horizontally to the left of and beyond the side of the vehicle, and by moving the hand in a circle.

Section 8. (Stopping on state highways.) (a) No person shall park or leave standing any vehicle, whether attended or unattended, upon a paved or improved or main traveled portion of any highway, outside of a business residential district, when it is practicable to park or leave such vehicles standing off the paved or improved or main traveled portion of such highway; provided, in no event shall any person park or leave standing any vehicle, whether attended or unattended, upon any highway unless a clear and unobstructed width of not less than 20 feet upon the main traveled portion of said highway opposite such standing vehicle shall be left for free passage of other vehicles thereon, nor unless a clear view of such vehicles may be obtained for a distance of 200 feet in each direction upon such highway, and further provided no person shall park a vehicle under any condition where official highway signs have been erected prohibiting the same.

(b) Whenever any police officer shall find a vehicle standing upon highway in violation of the provisions of this section he is hereby authorized to move such vehicle or require the driver or person in charge to move such vehicle to a position permitted under this section.

(c) The provisions of this section shall not apply to the driver of any vehicle which is disabled while upon the paved or improved or main traveled portion of any highway in such manner and to such extent that it is impossible to avoid stopping and temporarily leaving such vehicle in such position, provided, however, that such driver shall take all necessary steps to warn the public of the obstruction.

(d) No person shall park or leave standing any vehicle whether attended or unattended upon any highway within 100 feet of an intersection at which traffic control signals are installed.

Section 9. (Obstructing traffic.) No person shall drive any vehicle in such a manner as to unnnecessarily obstruct the normal movement of traffic upon any highway.

Section 10. (Obedience to traffic control signals.) Colors in traffic control signals shall have the commands ascribed to them in this section, and no other meanings, and no driver of a vehicle shall fail to comply with said commands.

(1) Red—While the red lens is illuminated no driver of a vehicle facing the signal shall enter the intersection provided, however, that if a right or left green arrow is illuminated at the same time, a driver may enter the intersection to make the turn permitted by the arrow.

(2) Yellow—While the yellow lens is illuminated any awaiting driver of a vehicle shall remain standing until the green lens is illuminated—and any driver of a vehicle approaching the intersection who is further from the intersection than the legal braking distance for the speed at which he is traveling at the time when the yellow lens was first illuminated, shall stop said vehicle before reaching the intersection, or a marked stop line.

(3) Green—While the green lens is illuminated any driver of a vehicle facing the signal shall proceed subject to the safety of those who may have been in the intersection at the time the lens was illuminated, and subject to the special turning restrictions contained in paragraph (5) of this section.

(4) Red and yellow—While the red and yellow lenses are illuminated together no driver of a vehicle shall enter the intersection and during such time the intersections shall be reserved for the exclusive use of pedestrians.

(5) Green arrow lens—When a special right or left turn green arrow lens is incorporated in a signal, drivers facing said signal may make a turn in the direction of such arrow, only when such lens is illuminated.

(6) Flashing red—The red lens when illuminated with rapid intermittent flashes shall indicate the intersection of a through way and shall require the drivers to come to a complete stop before entering the intersection.

(7) Flashing yellow—The yellow lens when illuminated with rapid intermittent flashes shall indicate the presence of danger and shall permit drivers to proceed only with caution.

Section 11. (Effect and repeal.) These rules and regulations are to be effective on and after October 26, 1929, and the department of public works hereby reserves the right after a hearing and with the approval of the Governor and council to alter, amend or revoke any or all of the foregoing rules and regulations.

Section 12. (Penalty.) Whosoever violates any of the provisions of these rules and regulations shall upon conviction be subjected to a penalty not exceeding $20 for each offense.

Machine Finishing for Hot-Mixed Pavement in California

The Use of Mechanical Means for Spreading, Raking, and Finishing Hot Asphaltic Mixture for Highway and Street Paving

By C. S. POPE

Chief Construction Engineer, California Division of Highways

THE purpose of this paper is not to provide a comparison between the asphaltic type of pavement and any other type, but rather to describe an important advance in improved structure in the asphaltic type and a more economical construction which has been made possible by the introduction of machine finish.

The information was obtained over a working period of about three years, during the construction of some 250 miles of asphaltic concrete surfaced highways and thousands of square yards of city streets.

Conclusions.—The advantages which have become apparent and the improvement in asphaltic construction which have followed upon the introduction of mechanical spreading and finishing have been summarized as follows:

(1) Removal of limitations on plant capacity, due to inability to handle large tonnages on narrow highways.

(2) Decrease in unit costs of asphaltic mixture, due to quantity production and quantity handling on the street.

(3) Greater uniformity of structure of the asphalt paving base and surface.

(4) Decrease in surface roughness to a point where there is now little difference between the best laid asphaltic type and any other type of pavement in this respect.

(5) Production of a uniformly smooth non skid surface which will be safe in any weather for a number of years.

(6) Elimination of poor workmanship through the substitution of machinery for hand labor on all of the more important phases of the work.

(7) Reduction in rolling due to the particular arrangement of the paving mixture previous to rolling.

(8) Decrease in plant and street costs due to mass production and decrease in general contract costs due to speed of operations as a whole.

History.—In this mechanical age, it may seem strange to you as it does to me that contractors were so many years in adopting the use of power operated spreading and raking machines for asphaltic concrete. Similar machines were readily accepted for producing smooth, well compacted concrete pavement, but the practical asphalt paving man always visualized innumerable difficulties which would assail him if he attempted to use similar machines on his work.

Proposals that it was feasible to spread and rake asphaltic mixtures with machines were met with many objections, since proved unsound. These objections impeded the general adoption of mechanical spreading for two or three years in California at least, after it was first suggested.

During 1924 and 1925, spreader boxes for spreading macadam rock came into general use and their success gave rise to our opinion that these boxes might be used to spread asphaltic concrete base, if contractors could be induced to try them. Their use on the first job on which they were tried allowed the contractor to take off a number of shovelers, so he was entirely agreeable to the next experiment which was to attach rakes to the spreader boxes to rake out the mix. This improvement allowed the contractor to take off one or two more men and convinced us that asphalt concrete could probably be raked and spread by machine methods.

Our spreader boxes were not so economical on the thin 1½ in. surface we were then laying in 1926, so we investigated the use of a large drag rake spanning the entire 20 ft. width of roadway to be folowed by a strike off screed. These implements were at first drawn by hand and later by horse power. Both implements operated successfully and gave us a surface smoothness superior to anything we had been able to obtain by hand raking methods, but did not tend to increase plant output.

Through the cooperation of one of the larger road machinery manufacturers, we secured a standard concrete finishing machine and proceeded to remodel it at our own expense and thus completed the first attachments for raking and finishing asphalt concrete by mechanical means.

This machine was furnished on trial by the state to one of our contractors engaged in resurfacing a 10-mile section of highway. The working out of the usual defects which seem inherent in a new machine caused us all more or less concern but in the end the machine got down to work and turned out an excellent job which showed a roughness of about half of what we had been getting by hand raking. The successful use of this machine was followed very shortly by a decrease in our costs of asphalt concrete paving.

Objects Sought.—The earlier purposes sought in the use of machines for raking and finishing asphaltic concrete pavement were several.

It was desirable to increase the amount of material which could be handled on the road beyond what was possible by hand spreading. Plant capacity could be increased by building larger plants and hauling equipment could be handled on the road, but because of the nature of the material it did not seem possible to place enough shovelers and rakers on a 20-ft. road to handle the greatly increased tonnage required for economical work. In other words, the spreading and raking operations constituted the bottle neck of the job.

It was desirable that smoother pavements be laid because of the unfavorable comparison which constantly arose between portland cement concrete pavements smoothly finished by machine methods and asphaltic pavements still finished by hand raking.

It was desirable that a non skid surface be constructed which, while smooth, would still afford as safe driving in rainy weather as was claimed for the portland cement concrete.

It was desirable to incorporate in the pavement construction such qualities as would insure a long life and freedom from objectionable waviness.

with asphaltic concrete a considerable mileage of state highways which had been constructed of portland cement concrete, usually 15 ft. wide and 4 in. in thickness. An unusual feature of this pavement was its high crown which averaged about 2¾ in. or about 3 per cent of the half width. This high crown eventually added about 1 in. additional average thickness for leveling course over the 15 ft. width.

Due to the enormous increase in traffic, to faulty foundations, to under-design of the slab and other causes, a considerable mileage of pavement began to show distress as early as 1916 or 1917 and the State began a program of reconstruction of these pavements to a width of 20 ft.

Highways in especially bad condition or which are subjected to truck traffic or to unfavorable climatic or topographic conditions are resurfaced with portland cement concrete; while those in better condition or which are located in the valleys or other more favorable locations are surfaced with asphaltic concrete.

The asphaltic concrete type of asphaltic pavement has been chosen gen-

erally in California because of its greater economy and durability and also from the fact that it presents a non skid surface for a longer time than other plant mixed asphaltic surface.

Preparation.—In modern resurfacing operations because of the greatly increased output, great care is necessary in planning to insure smooth coordination between the plant, the hauling equipment, and the spreading and rolling operations.

Plant.—I will refer briefly to certain plant arrangements which have a bearing on our practice. A plant of considerable capacity is desirable and common practice in California at the present time has fixed on plants producing from 2,500 to 5,000 lb. per batch as the economical size. Such a plant will turn out up to 65 batches per hour, if properly arranged and average outputs of from 500 to 800 tons per day are not unusual. While our specification limit output to 65 batches per hour, the number may be increased should our laboratory and field investigations indicate that improved methods introduced by the contractor will produce a satisfactory mix in a shorter mixing cycle.

We have found it desirable to premix all of our aggregate before it is passed to the proportioning bins and this is accomplished either by mixing in layers at stockpiles or less by means of chutes which deposit layers of coarse and fine aggregate on a belt running under the storage bins and which feed the dryer. Weighing boxes are always placed with their outlets at right angles to the mixing shafts with the pug mill instead of parallel with the shafts, since the latter arrangement has a tendency to defeat complete mixing of the different sizes of aggregate.

Hauling Equipment.—It is usually required that all hauling be done with pneumatic tired trucks.

Since the usual load of mixture varies from 5 to 6 tons, the dual type of tire is in common use.

Trucks are usually fitted with convenient coupling devices placed forward of the middle of the truck for ease in attaching the chains by which the spreader boxes are drawn.

Spreader Boxes.—Two usual types of spreader boxes are in common use one of which is equipped with skids on which it is dragged forward and the other is supported by means of rollers. Both are equipped with more or less satisfactory gates extending the full width of the back to permit spreading the mixture to the proper thickness. Some difficulty is experienced in making the ribbons of mixture deposited by the spreader boxes lap over each other without rock pockets developing. One of the best methods to secure this result is to cut holes about 6 or 8 in. square in the ends of the spreader box near the front of the box which will allow sufficient average mixture to run out to make the junction of the ribbons satisfactory.

We have found spreader boxes economical and satisfactory whenever a uniform thickness of surface of considerable depth is to be spread. Some contractors claim little saving where a surface less than 3 in. loose is to be spread. In spreading leveling course, contractors have resorted to numerous ingenious methods of spreading the surface of the course parallel with the true surface.

Side Forms and Rails.—Since it is now our common practice to require that side forms be left in place, such forms are of wood, 3 in. in thickness and as deep as the pavement.

They are supported on hubs at 4-ft. intervals and are securely staked to prevent lateral movement. We require all forms to be surfaced on both edges. While it is quite possible to spread base or leveling course from the wooden side forms, it is not possible to spread surface with spreading machines as at present designed.

It is necessary to make an allowance for compression and for this purpose it is common practice to lay flat steel rails about ¾ in. to ⅞ in. in thickness by 2½ in. to 3 in. in width on top of the wooden side forms to elevate the finishing machine a sufficient distance above the side forms to allow for compaction during rolling. These rails usually have a V-shaped or tongue and groove connection with each other to preserve alignment and are about 10 ft. in length. Usually three or four sets of rails are sufficient on the average job, as they are taken up and moved ahead as the work progresses. It is usual to nail the rails temporarily to the side forms.

Finishing Machines.—Two types of finishing machines are now in use in California, both of which will spread, rake, and finish asphalt concrete. Both types of machines are motor driven and consist essentially of front and rear screed plates set about 10 ft. apart, having a motion transverse to the pavement at the same time that the machine advances along the side forms. The raking elements are set in between the screeds and consist of steel pins set in heavy pipe, as described elsewhere.

We require not only spreading but also raking and respreading by the rear screed on all of our work and in this respect our practice differs somewhat, I believe, from other localities where spreading only without raking is a usual practice. Since we have not tried our machines on sheet mixtures, I am unable to say from actual experience whether raking of those mixtures is essential with a screed machine, but from a large experience in laying sheet asphalt by hand methods, I would consider raking such surfaces as essential as raking asphalt concrete.

The two types of rakes mentioned, and which I will designate as the pendulum type and the sliding type, represent the different ideas of the manufacturers, but they perform similar work.

The rake teeth which consist of steel pins from 8 in. to 14 in. in length and ½ in. to ⅝ in. in diameter are set 6 in. or less apart in two lines of double of thickness pipe of 2 to 2½ in. nominal diameter. The teeth are adjustable for projection and are fixed in place with set screws. The rake assembly extends the width of the machine, 10, 15, 20 or 30 ft., as the case may be. The essential difference in the two types of machine now in use is the method of raking used.

In one machine, the rake teeth swing with a pendelum motion in opposite directions which stirs up the mixture in line with the direction of travel.

In the other machine, the entire rake assembly slides backward and forward between guides, the teeth plowing under and lifting the mixture at each forward stroke, and on the backward stroke assisting perhaps the forward movement of the machine.

Both the pendulum and sliding motions are induced by means of an eccentric connected to a counter shaft and operating crank arms which swing the rake's teeth or cause the whole raking element to slide.

The teeth are set to rake at from 16 to 20 strokes per minute, and have a travel independent of the forward motion of the machine of from 4 to 8 in. It is not desirable that the rake speed should be too fast, nor the stroke too short. The sliding type of rake may have a longer stroke and be slower than the pendulum type.

Essential features of the raking are the lifting of the coarser aggregate to the surface of the mixture and the formation of compression ridges. The coarse aggregate being lifted to the surface allows it to be reimbedded in the immediate wearing surface by rolling, and thus forms a non-skid surface. The compression ridges between the furrows left by the rake teeth have a tendency to assist compression without distortion or travel in the mixture since the ridges are flattened out sidewise by the roller instead of being driven ahead by it.

Paving Operations.—The paving operations in the construction of base and surface are as follows:

Paving mixture heated to approximately 280° F. is brought to the road in pneumatic-tired trucks of 5 or 6-ton capacity.

If a leveling course is to be laid on old concrete, a paint coat of emulsified asphalt is first applied to the concrete base.

The trucks are backed up to spreader boxes and are attached to them by means of a quick detachable chain hitch.

The mixture is roughly spread about 2 in. thicker than it will be left by the finishing machine and is at once spread to a uniform thickness, using the screeds of the finishing machines only as a usual thing. Some operators use

the rakes also, as they think they assist compression. Rolling is begun as soon as the machines have spread a sufficient amount of material. Practically no hand work is required on the base mixture.

Base mixture is usually carried forward for such a distance as to allow a full day's run on surface, or for even a longer distance so that it will not be necessary to make so many shifts of the finishing machine. On one large job, at present under construction, two finishing machines are in use, one on base and one on surface, which obviates the necessity of moving either one back on the job. Machines are usually moved off the pavement at night to permit its use by through traffic.

Surface operations follow closely on the methods used in constructiong base with a number of additional operations, however. It is first necessary to lay steel rails ¾ in. to ⅞ in. thick on top of the side forms, as hereinbefore described, to give the screeds the proper elevation above the side forms to allow for compression in rolling.

The screeds, which are cut at the center, are adjusted to the correct crown by means of hand wheels. The rake teeth are lowered into the mixture and in the sliding type are set at an angle of about 45 deg.

During operation, it is desirable to carry a wave of mixture about half the height of the front screed in front of that screed and a smaller wave of mixture in front of the rear screed.

During the operation of the machine, the rakes are forming ridges and furrows longitudinal with the road and the rear screed is just knocking the top off the ridges, leaving coarse aggregate exposed for rolling. The machines are usually equipped for 4-wheel drive and will operate at a forward speed of up to 10 ft. per minute.

Rolling.—Rolling is done with 10-ton macadam rollers for the first compaction followed by 6 to 8-ton tandem rollers for final smoothing.

Following the first rolling of the surface, our customary practice is to scatter asphalt coated stone chips, passing ⅜ in. and retained on ¼ in., over the surface to fill any small voids which may be left in the surface and to provide additional assurance that the surface will be of uniform non-skid texture. Rolling is then continued until no more compaction is possible and the surface is as smooth as it can be made.

Smoothness.—Surface smoothness is checked during construction by several different methods devised by ingenious resident engineers. The simplest method is, of course, to use a 10-ft. straight edge, but as this requires a good deal of stooping, other means have been devised.

One automatic device consists of a straight edge on three wheels so arranged that a rise or fall of the central wheel of more than ¼ in. rings a bell; another has a similar bell arrangement, but the straight edge consists of two sled runners; while another is a weighted sled which scores the high points as it is dragged after the roller.

The official record of roughness, however, is recorded on a vialog or roughometer attached to an automobile operating at 20 miles per hour. This machine is left constantly calibrated by checking its operation over two or three standard sections of pavement which have been run over many times and on which roughness has been accurately determined.

The following tabulation indicates the average smoothness we have obtained on some 200 miles of asphalt concrete pavement laid in the last five years:

Year	Miles Laid	Roughness Index	Remarks
1924	23.84	30.1	Hand finish
1925	24.11	33.2	Hand finish
1926	49.34	24.1	Hand finish
1927	35.35	25.2-14.6	Machine finish begun
1928	60.81	30.9-14.7	

We have been able to reduce the roughness to as low as eight units on some especially well finished jobs without sacrifice of the non-skid feature.

We find that roughness increases with each year a pavement is in use. One of our asphalt pavements laid three years ago with a roughness index of 11 now has a roughness index of 14.

Output.—The introduction of finishing machines has, as stated before, greatly increased the average tonnage output of paving plants, and has also decreased the cost per ton as shown in the following tabulation:

Year	Tonnage Max.	Per 8-Hr. Day Average	Average Cost per Ton
1924	244	194	$7.27
1925	319	214	6.42
1926	388	333	5.13
1927	366	352	5.68
1928	574	404	4.89

Naturally, this increase in output has required larger plants and where a 1,500 or 2,000-lb. batch box was the usual size in 1924, we are now using batch boxes up to 5,000 lb. capacity with the cost of the plant in proportion.

Mixture.—The average asphalt concrete mixtures we use for base and surface show the following gradings:

Pass	Base Course	Surface
2½	90-100	
1¼	65- 75	90-100
¾	50- 65	75- 90
½		60- 75
#8	30- 40	40- 55
#10	20- 30	28- 36
40	12- 20	23- 27
80	6- 12	15- 20
200	2- 4	7- 11
A.C.	4.5- 5.5	4.5- 6.5

Stone dust is used in surface only, and is usually about 4 per cent of the total mix.

The modern methods of conveying, heating, proportioning and mixing are followed and do not form a part of this paper.

The average costs of materials at our mixing plants are about as follows:

Fuel oil $1.50 per barrel, asphalt $15 per ton, stone dust $6.50 per ton, sand $1.50 per ton, and rock $2 per ton.

Cost of Laying Asphalt Concrete.—The comparisons in Table I of the cost of spreading asphalt concrete by hand and by machine were taken from two jobs completed within the last two years.

Three hundred tons per day would have been a good day's work for a hand crew, but 600 tons per day is not an unusual day's work for machine spreading.

In conclusion, I wish to predict that the more extensive use of machinery in the construction of asphaltic pavements has opened a new era for this material, and that with the growth of knowledge as to the economic and engineering considerations which should govern the selection of pavement types, the use of asphaltic pavements in their proper locations will reach proportions sufficient to satisfy its most ardent advocates without detracting from the merits and usability of other types of pavement in their proper environment.

Table I

Output	By Hand 300 Tons per Day		By Machine 600 Tons per Day	
Labor:	1 at $8.00	$ 8.00	1 at $8.00	$ 8.00
Foremen			1 at 8.00	8.00
Machine operators	8 at 4.50	36.00	4 at 4.50	18.00
Shovelers	1 at 7.00	7.00	1 at 7.00	7.00
Rakers	2 at 6.00	12.00	1 at 6.00	6.00
Rakers	1 at 4.50	4.50	2 at 4.50	9.00
Dumpman or spreader box			2 at 4.50	9.00
Railmen	2 at 4.50	9.00	2 at 4.50	9.00
Screenings	1 at 4.50	4.50	1 at 4.50	4.50
Tampers	—		—	
Totals	16	$81.00	15	$ 78.50
Spreading cost per ton		$ 0.27		$ 0.131
Machine rental per day				15.00
Gas and oil per day				1.20
				$16.20
Cost of machine per ton				$ 0.027
Total cost of spreading by machine per ton				.158

Mexican Students Being Sent to the United States.—Announcement has been made by the Mexican National Highway Commission that, by arrangement with the American Road Builders' Association, students are being sent to the United States for instruction in highway construction and machinery. The members of the first group of students have already completed their studies and a second group has been sent to take instruction.

A Method of Increasing Endurance Factor of Concrete Pavements

A simple yet effective method designed to increase the endurance factor of concrete pavements consists of covering the subgrade with an impervious membrance before laying the concrete slab thereon. This method is the Monolite Process, a development of the Monolite Co. of America, 1004 Hearst Bldg., San Francisco, Calif. The membrance consists of a waterproof felt known as Monofelt, sealed at the joints with a waterproof compound, thus divorcing the concrete slab from the subgrade. Many advantages are claimed for this process, chief among them, from the engineer's point of view, being the increase in tensile strength at the bottom of the slab, the increased ultimate strength due to prolongation of the curing process and the reduction of temperature stresses in the slab due to elimination of much of the frictional resistance to expansion and contraction. The latter is believed to be very important, as it has been observed that failure often occurs from fatigue which is probably accelerated by frequent overstressing from this cause.

Pavement slabs are subjected to influences which do not occur in the ordinary use of concrete in building construction. The thickness of the slab is comparatively small and it is subjected not only to variable weather conditions at its top surface but also to variable soil and moisture conditions beneath. Due to the small slab thickness these conditions influence a material portion of the entire volume of the slab. Various curing methods have been devised and used to remove detrimental influences from the top surface of the slab, but unless care is taken of the bottom of the slab the work has been half done.

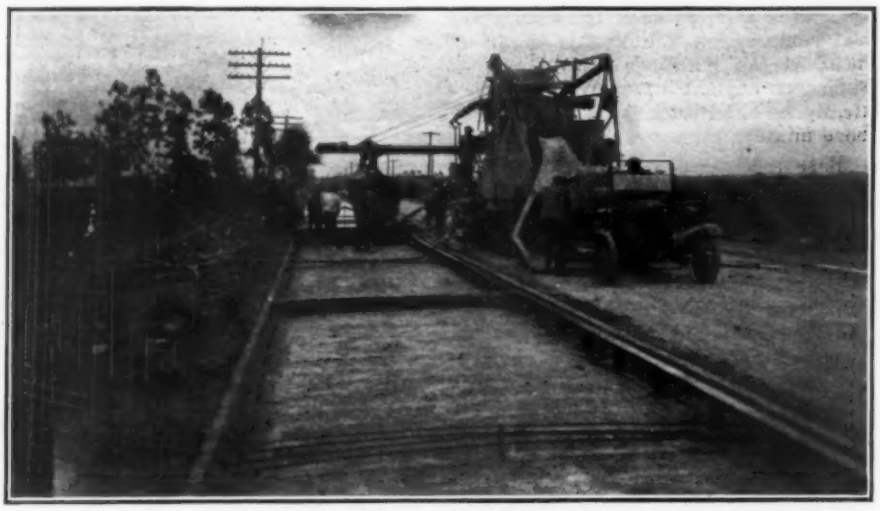


Fig. 1—Concrete Being Laid by the MonoliteProcess on an 11 Ft. Pavement Widening In California, Illustrating the Method of Reinforc-ing in Separate Slabs and Placing Expansion Joints at 60 Ft. Intervals

The following advantages of this process are stated to have been demonstrated.

(1) Increased tensile strength at the bottom of the slab. Comparative tests made on the California State Highway System in August, 1898, showed a ratio of modulus of rupture to crushing strength at 28 days of .174 for the plain pavement and .198 for Monolite pavement.

(2) Monolite pavements increase in strength much more rapidly than plain concrete pavements. The same test above described showed an increase in crushing strength from 11 to 28 days age of 9 per cent for plain pavement and 24 per cent for Monolite pavement. Increase in modulus of rupture of beams from the same pavement showed an increase strength at ages of 14 to 28 days of 4 per cent for plain pavement and 16 per cent for Monolite pavement.

(3) Reduction of friction between pavement and subgrade with resultant reduction of temperature stresses. An article in Public Roads Magazine, May, 1929, described tests made to determine the stresses set up by subgrade friction, which stresses were found to be much less in the case of pavements laid on waterproof felt than directly on the subgrade.

(4) It affords a permanent protection for the bottom of the slab. Test slabs laid in 1921 still have they felt adhering to them in its original state forming a permanent protection.

(5) It prevents both hair cracking and other cracking occuring prior to the final set. This has been demonstrated many times and in many places and the experiences of the State Highway Department of Iowa were given by Mr. R. W. Crum in an article in Public Roads Magazine August, 1925.

Many other advantages are claimed by the process appealing to both the engineer and the contractor. Not the least among these is the elimination of wetting the subgrade, thus improving construction conditions, avoiding change of volume due to wetting, increasing the pavement yardage per cubic yard of concrete and saving the labor and water used in this operation. Another advantage is the ability to use a lower water-cement ratio without sacrifice of plasticity when the pavement is laid on the Monofelt base, since the water is forced up through the mix by the tamping and screeding operation instead of being absorbed by the subgrade. This also improved the finishing operation by providing a well lubricated surface without requiring any additional sprinkling during the finishing, as is sometimes acquired when too dry a mix is used.

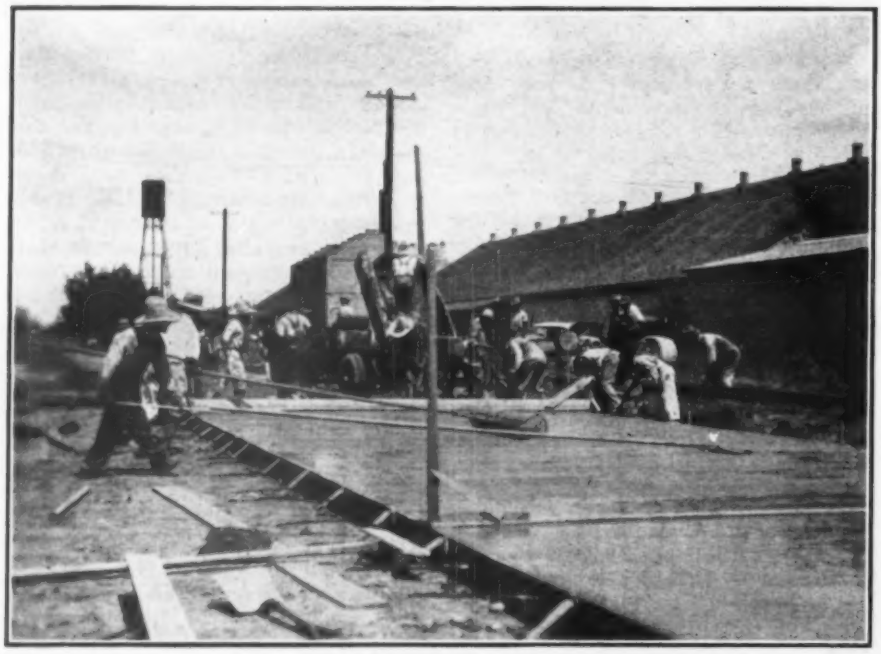


Fig. 2—A Monolite Pavement in Texas Immediately After the Float Has Passed, Illustrating How the Water Is Brought to the Top and Is of Aid in Obtaining a Good Surface Finish

Black Base and Track Paving at Charleston, S. C.

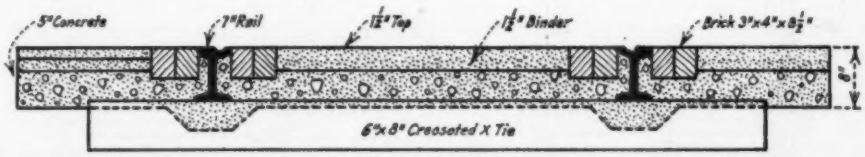
Pavement Construction on Saturated Fill; Also Method of Paving Street Railway Track to Eliminate Effects of Vibration at Pavement Edges

By J. H. DINGLE
City Engineer, Charleston, S. C.

A HISTORY of the roads, streets and pavements of Charleston, S. C., a city of 73,000 inhabitants, founded in 1670, would most probably indicate marked parallelism to that of a majority of the older cities of the United States. Evidences of transition from trail to lane to street, avenue or boulevard, can be found in the narrow crooked streets of the older sections, the wider, straighter thoroughfares of the more modern sections, the lack of uniformity in the old, the more regular plan, with still possibilities for improvement, in the new. In character of road coverings also this transition is noticeable, extending through many types from cobblestone, a matter of civic pride in early days, to modern pavement, and of these types a variety of interesting exhibits were still extant in even comparatively recent years.

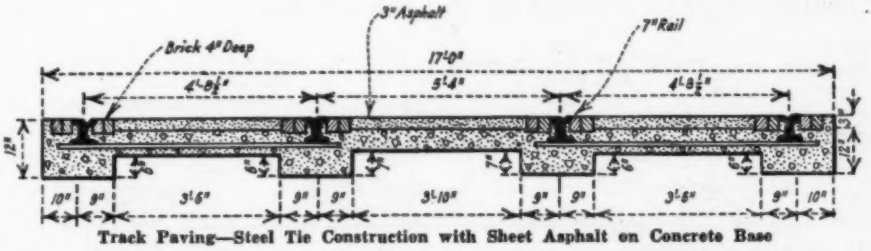
In its search for a low-priced first cost pavement, commensurate with its revenues, Charleston has, in the past, tried plank, oyster shell, pyrites cinders, waterbound macadam, clay-gravel and still has, more as an exhibit, however, than for paving value, a few city blocks paved with cobblestones, brought in the old days as ballast by sailing vessels coming to Charleston for cotton cargoes. In more recent days granite blocks, vitrified bricks, creosoted wood blocks, asphaltic concrete and sheet asphalt have appeared. The site of the city having been originally cut by numerous creeks and having included large areas of marsh and mud flats, underground conditions are uncertain and street subgrades vary from virgin soil with good bearing power to filled areas over former creeks with the uncertain support furnished by such conditions.

The First Sheet Asphalt Pavement.—Prior to 1912 the cost of paving improvements was met by a general tax levy inversely proportional to the other tax requirements of the municipality. The issuance of bonds for street improvements was impossible since the constitutional limit of bonded indebtedness had already been reached. In 1894, by pooling the revenues of several years, the first sheet asphalt pavement was laid in Charleston along East and South Battery, a pleasure drive about ¾ mile long, previously paved with oyster shell. This pavement consisted of a Rosendale cement concrete base, a binder course 1 in. thick and a 2-in. surface course. The binder was composed of gravel and hot coal tar pitch in the proportion of between 20 and 25 gal. of pitch to 1 cu. yd. of gravel. The surface mixture was 15 per cent to 18 per cent asphaltic cement, 65 per cent to 70 per cent of clean, sharp river sand and 15 per cent to 17 per cent of pulverized carbonate of lime. The pavement was rolled by hand-rollers, dusted with hydraulic cement and then compressed by a heavy steam roller. The gutters for a width of 12 in. were coated with hot pitch and smoothed with hot smoothing irons. A guarantee for five years was included in the first cost and at the expiration of this time, payment of 35 ct. per square yard extended the guarantee for an additional five years. This stretch of sheet asphalt although subject to drenching with, and even submergence under, salt water during storms, when the sea breaks over the adjacent sea wall, gave excellent results for nearly 21 years and in 1915 was resurfaced with 1½-in. binder and 1½-in. top over the original Rosendale cement concrete base. The old binder when removed was in a disintegrated condition and the old surface was brittle and lifeless.

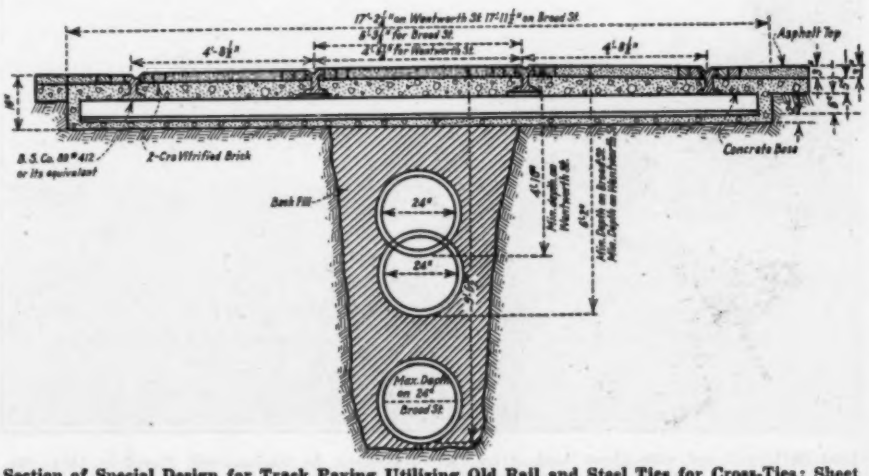


Track Paving—Creosoted Cross-Tie Track Construction with Sheet Asphalt on Concrete Base

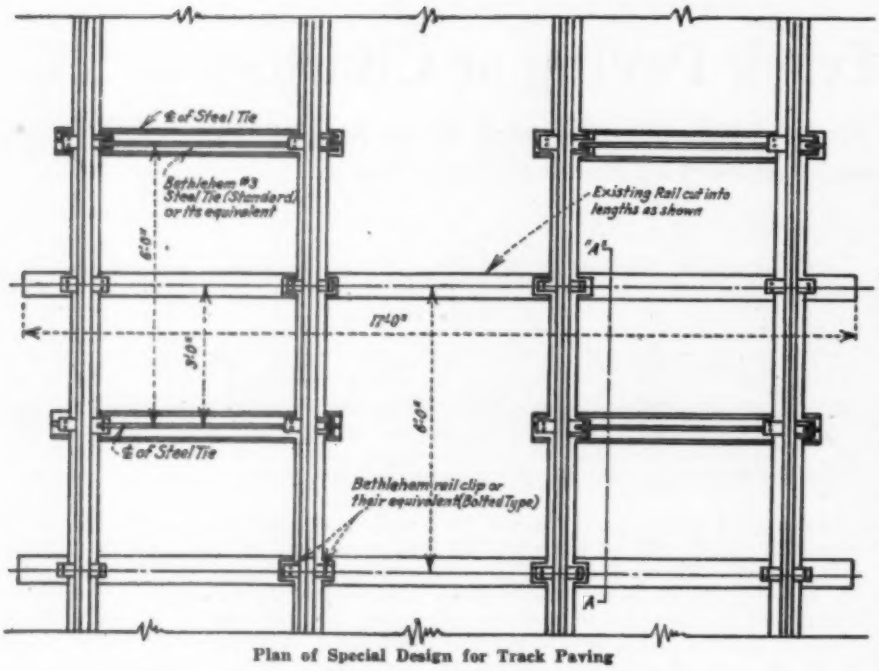
Financing Paving.—About 1912 the demand for more and better pavements became insistent and was crystallized in an amendment to the state constitution enabling the passage in 1913 of an "Abutting Property Paving Ordinance." Under this ordinance property was assessed for one-half of the cost of abutting pavement. The city paid, through the general tax levy, for the remaining one-half as well as for street intersections, drains, curbs and sidewalks. Considerable benefit, evidenced by increased yardage of modern pavement, attended this ordinance, but more progress was



Track Paving—Steel Tie Construction with Sheet Asphalt on Concrete Base

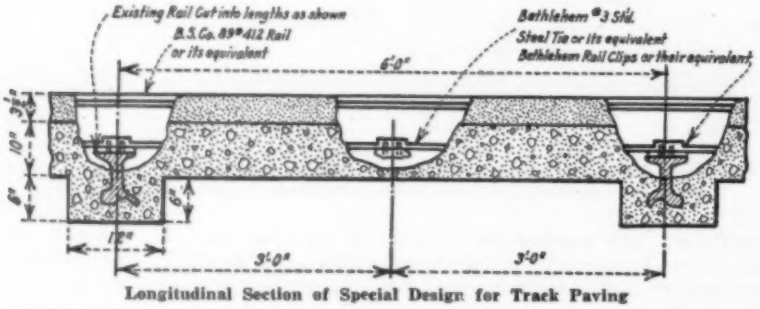


Section of Special Design for Track Paving Utilizing Old Rail and Steel Ties for Cross-Ties; Sheet Asphalt on Concrete Base



Plan of Special Design for Track Paving

demanded, and in 1922, after numerous legal preliminaries, there was enacted the present ordinance under which the abutting property is assessed for the full cost of curb, sidewalks and roadway, including intersections, and where drainage is necessary, is also assessed for a 12-in. storm water drain with appurtenances. Paving assessment bonds are issued and property-holders are allowed ten years within which to pay their assessments.

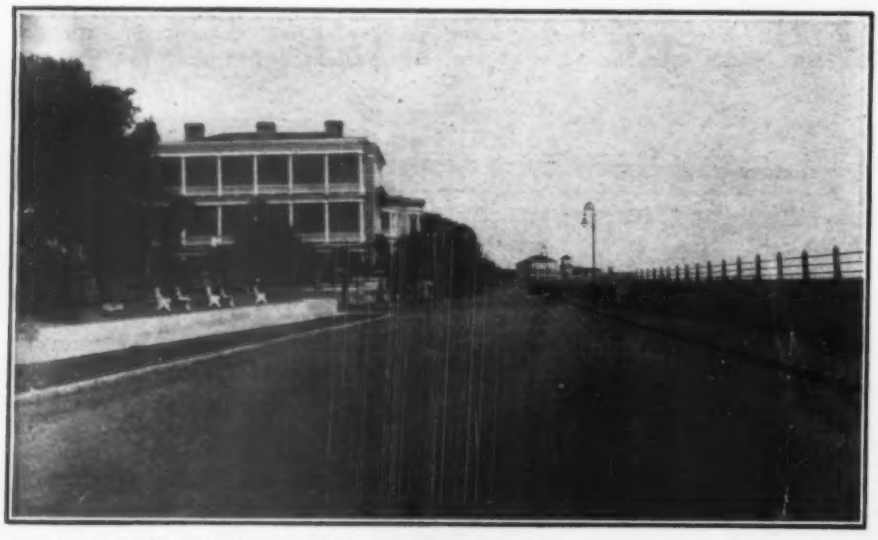


Longitudinal Section of Special Design for Track Paving

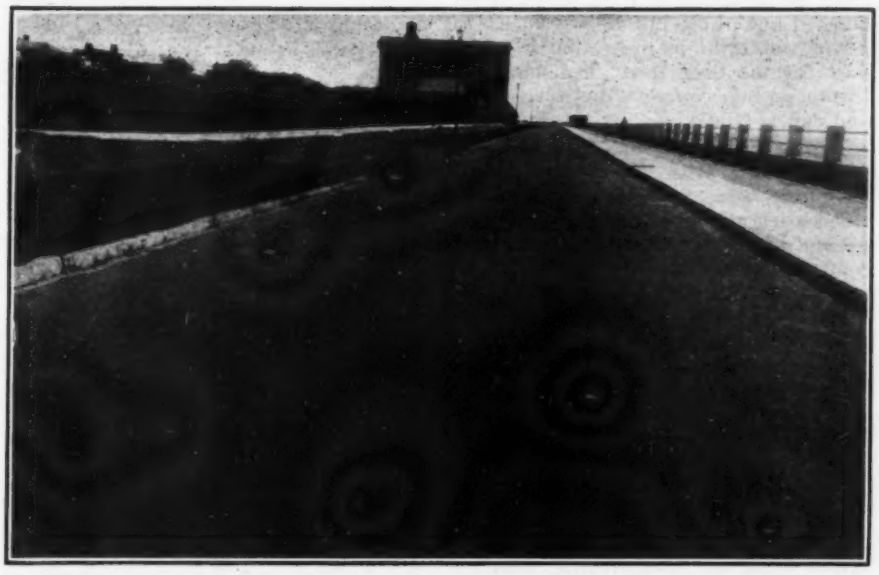
From the passage of the first abutting property ordinance to the present time, asphalt has been the accepted pavement and has increased from 0.7 mile in 1912 to 8.5 miles in 1921 and 55 miles in 1929. During the same time five types of road covering have been eliminated, so that, exclusive of earth roads, Charleston has now practically three types of pavement. Charleston's sheet asphalt is generally laid on cement concrete base, 5 in. thick, the exception being about 50,000 sq. yd. which because of poor sub-soil conditions, are laid on asphaltic concrete base in the so-called boulevard area. This area extends along the southern and southwestern river front and was reclaimed from the river by constructing a sea wall and filling the area thereby enclosed with mud and sand, principally mud, pumped from the river bed. The reclamation was completed in the latter part of 1911. The bottom, on which the filler was deposited, was soft mud; piles 50 to 75 ft. long had been required in the construction of a foundation, for the wall along which the original depth of water was, in places, as much as 6 ft. below mean low water. The maximum depth of fill therefore, from original river bottom to grade, was 14.5 to 15 ft. Grade 3½ to 4 ft. above mean high water or 1 to 1.5 ft. above spring tide.

Paving with Flexible Base on Saturated Fill.—The worst conditions, relative to road construction, existed in the area planned for a river-front drive, extending along the sea-wall and separated by only the width of the sidewalk from the river, the tides of which saturated the fill to within 4 ft. of grade twice in every 24 hours. The supporting power of this fill was a matter of conjecture. However, streets were marked out, curbs laid (some on plank), storm-water drains and sanitary sewers constructed on pile foundation and a 6-in., after compression, layer of oyster shell was laid as a road covering and added to from time to time. The drive along the river front became popular and maintenance troubles began. In places the sub-grade, in wet weather, oozed up through the oyster shell covering and again the oyster shells would disappear into the sub-grade under the lines of traffic. In 1925 it was decided by the city council to improve the river front drive as well as the other streets in this area and the type of pavement best adapted to the conditions became a matter of serious consideration. The situation seemed one in which the qualities of a rigid base, useful under other conditions, would prove objectionable. Settlement was sure to continue withdrawing from a rigid base uniform support and coverting such a base into a beam, or rather floor slab, of varying span length and characteristics, liable to failure at any time when conditions of load and span should exceed its powers of resistance.

The advantages of the flexible base, with special reference to maintenance of contact between base and subgrade: non-absorbent qualities of base and homogenity of base and surface course



East Battery Paved with Sheet Asphalt on Concrete Base. In Background, Paved in 1894; Resurfaced in 1915. In Foreground, Pavement Laid in 1925



Murray Blvd., Paved in 1925 with Sheet Asphalt on Black Base. Two Roadways Separated by Center Grass Strip. One-Way Traffic on Each Roadway. Cracks Due to Poor Subsoil. Traffic Lane at Right in Better Condition Than Less Travelled Pavement at Left

useful attributes under wet conditions: ease, rapidity and low cost of repairs which conditions promised would be not infrequent: these led to the adoption of asphaltic concrete base for a sheet asphalt surface.

Construction Methods.—The roadway was rough graded and a sufficient amount of the poorer material removed to permit the deposit of a 12-in. layer of cinders below subgrade. These cinders were rolled in two 6-in. layers with a 10-ton roller care being exercised not to lose the roller. Soft spots were dug out and filled with cinders and again rolled. Hauling over sub-grade was prohibited except on plank flooring. On the rolled cinder sub-grade an asphaltic concrete base 4-in. thick, was laid. The wearing surface was 1½-in. sheet asphalt.

This black base pavement, 50,000 sq. yd., in a section popular with the natives and of much interest to visitors, carries daily a large amount of pleasure traffic and has cost nothing for repairs or maintenance since its construction four or five years ago. Settlement, not sufficient for discomfort in driving, is evident here and there and in places thread cracks have appeared on the surface due to subsoil conditions. The cracks can at any time be obliterated by the application of a seal coat and should settlement reach the point of discomfort, depressions can easily, and at low cost, be raised by the application of materials of same type as those originally used in the road by the bonding of which with the old material, a coherent structure is maintained.

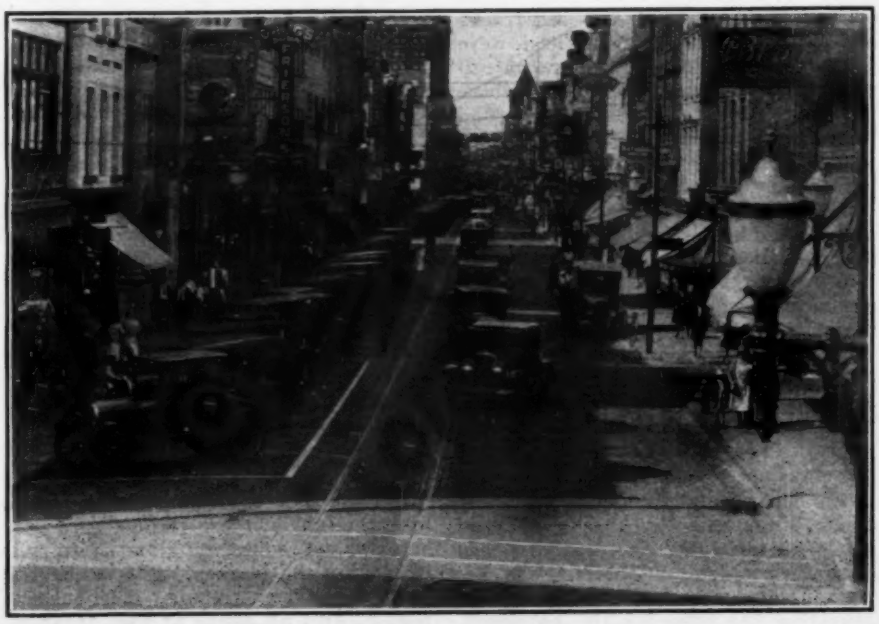
The driveway on Murray Blvd., along the river, is divided by a center grass strip, 12 ft. wide, into two roadways, 19 ft. wide each. One-way traffic prevails on each roadway. It is noticeable that the traveled portions of the two roadways show fewer surface cracks than the portions less frequently used. Surface disturbance is more evident in the paving along the center grass strip and in the cross-overs where traffic is infrequent.

In patching openings in sheet asphalt pavement on cement concrete base, black base is at times used where expedition is important or where comment concrete is not readily available.

How Pavement Cutting Is Controlled.—The preservation of pavements is next in importance to financing and properly constructing same and Charleston has made a special effort to discourage indiscriminate tearing up of pavements and to control repaving where absolute necessity demands that pavements be disturbed.

City ordinance requires that before the commencement of paving operations ample notice be given by public advertisement supplemented by special written notice to public service corporations advising that certain streets mentioned in the notice are about to be paved; that all work requiring excavation or other disturbance of the street must forthwith be undertaken and must be completed by a definite date also mentioned in the notice, after which date no permit for disturbance of pavement will be issued except in case of some special emergency. Backfilling of trenches and repaving are done by city workmen and the cost charged, in accordance with a regular schedule of prices, to the plumber, contractor or other who opened the pavement. Since in most of our streets underground construction needs attention in advance of paving operations, the activities in repairing or reconstructing drains, sewers, gas and water mains with the accompanying house connections and services which are constructed from mains to curb in all streets which are about to be paved, leaves very little of the old pavement in place and thus precludes surfacing over old granite brick or other pavements which might otherwise be utilized as bases. In the effort to preserve its pavements, Charleston has attempted to reduce to a minimum possible damage from street railways and steam railroads. The street railway franchise specifies the use of a grooved girder rail. Steam roads, crossing modern pavements, use Tee rail provided with guard rail.

Street Railway Track Paving.—Experience indicates that vibration due to street railway traffic is destructive of asphalt pavement when the latter is in direct contact with the rail. The asphalt in a short time is displaced and curls up on each side of each rail, pro-



King St., Paved in 1928 with Sheet Asphalt with Two Rows of Vitrified Brick Along Each Side of Each Street Car Rail

ducing inequalities unsightly to the eye and uncomfortable to drive over. This condition is intensified as portions of the asphalt are broken off by traffic leaving a longitudinal depression between the rail and a ragged edge of pavement. The first attempt to remedy this involved the use of creosoted wood-blocks laid along the rail as a separator or cushion between rail and asphalt pavement. The blocks were 3 in. wide and 3 in. deep, the combined depth of binder and top, and two courses were laid as stretchers along each side of each rail supported by the concrete base and forming a strip 6 in. wide between asphalt and rail. The concrete base under the wood block was depressed a fraction to allow the blocks to be set in a thin bed of cement mortar and the space on each side of each rail between the web of the rail and the blocks was filled with cement mortar to provide vertical faces flush with the edges of the top of the rail for lateral support of the blocks. The joints between blocks and between rail and blocks were poured with asphalt filler. In a few years the tendency of wood blocks to swell in wet weather and shrink in dry weather, led to the adoption of vitrified brick for use adjoining the rails. The same construction is followed as in the case of wood blocks, except that the use of brick 4 in. deep necessitates a depression of 1 in. in the concrete base which is obtained with little effort before the concrete base has set.

Special Type of Construction.—On a recent piece of construction involving sheet asphalt pavement, drain construction and rail renewal on a double track street, a special type of construction was adopted. The drain, 24 in. in diameter, 9½ ft. deep, was located between the tracks, the construction of which in such close proximity to a fresh fill caused uneasiness. Old steel rails, 6 in. deep, were cut into lengths of 17 ft. 6 in., sufficient to underlie both tracks and crossing the new fill. These were spaced 6 ft. centers with base of rail uppermost. Between each pair of these rail-ties were placed Bethlehem steel ties underlying only one track each so that long and short ties alternated. The base of the operating rail was electrically welded to each old-rail cross tie and secured by bolted clips to the standard steel ties. The fish plates at rail joints were bolted with two bolts and electrically welded around the entire perimeter. Incidentally this obviated the necessity of electrical bonds. All compromise joints, where straight work met special work, and all special-work joints were thermit welded. The rigid joints are particularly valuable in the preservation of pavements.

The inner rails were elevated ½ in. above outer rails by means of steel shims ½ in. thick, electrically welded at both contacts. Concrete was deposited, encasing the tie system and providing the base for the pavement. The general depth of concrete in this track construction is 7 in., which is increased at the old-rail ties by 6 in. for a width of 12 in. as protection and support for the long ties. The minimum thickness of concrete between steel and soil is 2 in.

This construction has proven quite effective and with the sheet asphalt pavement, with a double course of vitrified brick along each side of each rail, presents a creditable appearance and is comfortable for use, costs but little to maintain and promises long service.

Acknowledgment.—The foregoing is a paper presented at the 8th annual Asphalt Paving Conference, held Oct. 28 to Nov. 1 at West Baden Springs, Ind.

Belt-Line Roads to Aid City Traffic

Belt-Line highways skirting the larger cities of Pennsylvania, thus relieving the heavy traffic sections, are being studied by the Pennsylvania Department of Highways, Secretary James Lyall Stuart has announced. Philadelphia is the first city under consideration. Mr. Stuart discusses the problem as follows:

Following the old adage that the "longest way around is the quickest home," local residents will find a belt-line route a tremendous time saver. Tourist travel, with Philadelphia as one of its destinations, would not be served by such a highway as the travellers are intent on seeing the city.

"Every growing city reaches a stage at which some solution of its 'downtown problem' becomes urgent." The most cursory view of the problem reveals a natural grouping of the various traffic types, which might be roughly classified thus:

Local delivery, serving business and patrons.
Local transit passenger service.
Employees driving to and from work.
Local and suburban residents intra-city.
Tourists, visiting.
Tourists, through.

"The first two groups are bound to follow present routes in the pursuit of their businesses. Employes have largely solved their own problems by parking at the edge of the city and using transportation facilities to the center.

"The next three groups, furnish the meat of the problem. Intra-city traffic is largely of a cross-town nature and the American habit of taking short-cuts leads the bulk of this group to go through the downtown section, contributing to the congestion there. A fast belt-line, even outside the city limits, would increase the distance but actually cut down the time consumed in making the journey. It is apparent that an enormous number of suburban people, with no desire to pass through the business section, do so as a means of getting to their destinations, which often are outside the city.

"A tourist visiting the city for sightseeing, unless he stops with friends or relatives, usually endeavors to see as much as possible by driving through the heavily travelled districts. He has no use for a belt-line route. His leisurely drive through the business district is one of the factors contributing to congestion, along with the unfamiliarity with traffic rules, directions and one-way streets. This latter feature undoubtedly prolongs his drive by many miles travelled in search of an inlet or outlet to the one-way lane, but sometimes he stops to puzzle it out while traffic piles up behind him.

"Despite his undisputed contribution to downtown traffic congestion and delay, no person would entertain the difficult alternative of taking down the city's welcome sign and turning the tourist away. But thousands of tourists with no desire to see the city are forced to drive through it as a means of getting to other points.

"Through tourists are unwillingly delayed by downtown traffic and just as unwillingly they are delaying local residents who have legitimate business and social errands. Tourists and suburban residents with no purpose in passing through crowded streets, other than to reach distant points, are simply the last straw to overburdened streets.

"Our study already has proved conclusively to us that an invitation to dodge traffic by using a belt-line route around it would find a hearty response," Stuart said in conclusion. "It would be much easier at Philadelphia, for instance, to go from Media to Langhorne on such a route. Philadelphia's 'City Line Avenue' is an example of the belt-line idea but the city has outgrown it."

Highway Sidewalks

It is almost universal in connection with town, county and state highways that the entire roadway which was formerly available for pedestrians is now taken up with more or less congested automobile traffic, with no sidewalk provisions, rendering the streets absolutely unsafe for pedestrians. In this connection the following resolution presented at the last annual meeting of the American Society for Municipal Improvements is of interest:

WHEREAS, in connection with road and highway development on the part of outlying sections of municipalities, towns, counties and states, there is a nearly universal absence of sidewalk provisions for the safety and convenience of pedestrians;

BE IT RESOLVED, that the American Society for Municipal Improvements, at this 35th annual convention, held in the city of Philadelphia on Oct. 14, 15, 16 and 17, 1929, record the importance of sidewalk provisions in connection with all public highways subjected to considerable automobile traffic; and that the secretary prepare an appropriate communication embodying this resolution and secure its publication in engineering and municipal papers and distribute to all members of the American Society for Municipal Improvements, urging their activity, including bringing the matter to the attention of the public and officials in their home communities.

Oiled Runways for Airports

Method of Constructing "Mixed in Place" Landing Strips at Airports in the Southwest

By JOHN A. HERLIHY

Chief Engineer of the Transcontinental Air Transport, Inc., St. Louis, Mo.

THE rapid increase in air traffic in the past few years has brought forcibly to mind the necessity of paved runways for airports. The purpose of this paper is to point out the necessity for such runways and to describe the methods of building them with particular reference to the use of asphalt pavings.

The two main reasons for the necessity of paved areas are first to insure the operation of heavy transport planes during wet weather and secondly to eliminate the dust nuisance so long associated with airports. This latter item, together with the smooth landings and take-offs possible on paved runways, is very important to passenger carrying airlines.

It is obviously impracticable to consider paving or surfacing the entire area of the airport. The natural solution was to surface certain areas of the field called taxiways and runways.

Size of the Runways.—The size of those runways has been a subject of much discussion. For runways which are to be used as take-off strips only, 90 ft. is ample width. For landing strips the runways should be at least 120 ft. in width. It is true that under ideal conditions a pilot can land his plane on a very narrow runway, but if there is a cross-wind, if one tire is flat or if one brake should stick a little 120 ft. is about as narrow as it is safe to use. Then there is also the problem of turning the ships around on the runways. Again, under ideal conditions, a pilot can brake one wheel and turn very sharply, but in a strong wind, it is difficult to handle planes on the ground.

The length of runways required varies with the altitude above sea level. They do not, in general, need to be the full length of the field, but at sea level, where the Department of Commerce requires 2,500 ft. of clear field, the paved area should be at least 1,500 ft. of that length. At 5,000 ft. above sea level, the Department of Commerce requires runways about 4;000 ft. long, but 2,500 ft. of paved area is ordinarily sufficient.

There have been as many different methods of airport surfacing as there have been of highway surfacing. These include gravel, sand-clay, cinders, oil and asphalt pavements of all types and concrete. In this paper, only the oil or asphalt pavings will be discussed.

Properly designed asphalt paved runways will easily support the weight of the heaviest transport planes and give a smooth, resilient, dustless surface. They are not prohibitive in first cost and are easy to install and maintain.

The chief objection to oiled runways is their color. For night landings, the problem of properly lighting an airport having oiled runways, is more difficult than if they were of a light color. If an asphaltic compound of a light sand or cream color can be developed it will be a real step forward in airport runway paving. If white strips about 4 ft. in width are built at the borders of the runways, it will help materially in offsetting the light absorption of the black pavement.

Types of Oiled Runways.—There are many different types of oiled runways, each suited to a special purpose. Hard, smooth pavements are desirable for taxiways and areas near passenger stations, etc. Hard runways are also very desirable as take-off strips, but for landings, a softer, more resilient surface is desirable. The Grand Central Air Terminal at Glendale, Calif., is an example of a field with separate take-off and landing strips. The take-off strip is of concrete 3,000 ft. long and 72 ft. wide, flanked on both sides by a strip of asphalt 12 ft. in width. The landing area is approximately 400 ft. wide and 3,500 ft. long. It is made of a 4-in. mixed-in-place "plastic mix" oil pavement. This arrangement is very satisfactory. If a runway is to be used for both landings and take-offs, it should be fairly soft and resilient.

Construction Method on Field in Southwest.—The method in general was as follows:

The runways were made by the "mixed-in-place" method. In other words, the oil and the soil were mixed in place on the ground. The method is readily adaptable to desert country having fine sandy soil containing not too much organic material nor containing more than a trace of calcium sulphate or sodium sulphate, which have a detrimental effect upon the oil, causing it to lose its binding properties. The process was used on a wide variety of soils.

The first process is to analyze the natural soil, which should show a fairly uniform grading from 200 mesh up to ½ in. If the natural soil is not properly graded, it will be necessary to bring in foreign material of such a size as to make a uniform grading of the mix between the limits given above.

The thickness of the runways will depend entirely upon local conditions. If its function is almost entirely dust protection and there is no problem from rain with the possibility of bogging down the plane, then about a 2-in. cake will be sufficient. If it is necessary to build a runway which will hold up under heavy rains, it should be about 4 in. in thickness.

The runway is prepared for the application of the oil by a thorough harrowing with a disk harrow, thoroughly mixing the natural soil with the foreign material, if it is used. After mixing the soils, the oil is applied through a force feed spreader in separate applications, of approximately ½ gal. per square yard. The oil used was a 60-70 per cent asphalt oil of 80 penetration at 77° F. After each application the runway is again harrowed to thoroughly mix the oil and soil. Ordinarily, it will take about three-fourths of a gallon of oil per square yard per inch of thickness of runway. The finer the material the more oil will be necessary.

After all of the oil has been applied, it is mixed by blading it back and forth across the runway with an ordinary blade grader set at an angle about 45 deg. with the direction of travel. This blading serves to thoroughly mix the oil and the soil and is a very important part of the process. It will ordinarily be necessary to blade the mix from twenty to thirty times to get a thorough combination of the materials. In wide runways, it will be advisable to blade the material up in windrows about 15 ft. apart and then blade it back and forth. When the material is thoroughly mixed, it will have a dark chocolate appearance in the windrow and will be thoroughly uniform in color. The mixture should be live and tend to crawl when disturbed with a stick or other instrument.

The next process is to lay the material down on the surface in a layer of uniform thickness. This is done with a straight blade and will require very careful work to get a good job. After it is laid down it should be rolled with a light roller or preferably by a truck with large pneumatic tires. This will give a seal to the surface as well as compact the material underneath. It will probably not be advisable to use a heavy roller, which would be liable to leave waves in the surface.

Care should be taken not to apply any oil while the materials are wet nor attempt to do any mixing while they are wet.

These runways will give a smooth, tough and resilient surface, excellent for the landing and taking-off of airplanes. If material not over ½ in. in size is used, they will remain fairly soft, permitting ships with tail skids to

land comfortably with little danger of ground looping.

If harder runways are desired they could be obtained by using coarser material, say up to 1 in. in size. We made runways this way on one of our fields and they have set up very hard, similar to macadam roads.

The chief advantage of these runways over other methods is the saving in cost and the ease of construction. They can be built for less than half as much as almost any other form of paving and for most conditions, and rather dry countries, will give equally good results. By carefully handling the drainage problems using under drains, they could be readily adapted to country having considerable rainfall.

To give you some specific examples of the way in which some particular problems were handled, I will describe the work at two of our fields.

Methods at Winslow, Ariz.—At Winslow, Ariz., the soil was a fine red sand and silt. The mechanical analysis and classification were as follows:

Mechanical Analysis

Sieves, Passing	Per Cent, Individual	Per Cent, Cumulative
200 mesh	14.8	14.8
100 mesh	22.6	37.4
80 mesh	6.2	43.6
50 mesh	9.8	53.4
40 mesh	4.2	57 6
30 mesh	6.5	64.1
20 mesh	5.6	69.7
10 mesh	2.6	72.3
¼ mesh	8.8	81.1
½ mesh	10.4	91.5
¾ mesh	5.3	96.8
1 mesh	3 2	100.0

Classification

	Per Cent
Clay	3.8
Silt	11.0
Sand	57.5
Rock	27.7

This soil in its natural state would take oil readily and would very likely have made a good pavement. However, on account of the large percentage of fines, it would have taken an excessive amount of oil and would have been very difficult to work. The areas which we had dragged over and smoothed up were covered with a fine floury soil ankle deep in places, so it was decided to use sand and gravel in connection with the natural soil.

About 2½ in. of sand and gravel, all passing a 1½-in. screen on a 45 deg. slope, was used. This was spread over the runway area evenly and then gone over with a heavy disc harrow to mix it thoroughly with the natural soil.

The oil was then applied with a force-feed spreader at the rate of 1.9 gal. per square yard, applied approximately ½ gal. at a time. Between applications, the runway was gone over thoroughly with a disc harrow to start the mixing and bring fresh material to the surface. (It might be mentioned that the surface was so soft at times we had to use a tractor to haul the oil truck.)

After the final application of oil the runways were again disced in two directions and then mixing with the blade was started. The blade was set at 45 deg. and just low enough to catch all the material, which had received oil. The mix was then bladed back and forth in windrows about 15 ft. apart until it was a uniform chocolate brown in color. This required 22 turnings. The windrows were then laid down to form a smooth material 3 in. in thickness over the entire area. Dragging with a heavy road planer was attempted in order to compact the mix, but it had a tendency to bring the larger gravel to the surface, which was not desirable, so its use was discontinued. Traffic compaction, of course, is ideal for this type of paving, giving a compaction from the ground up. Therefore, trucks with large pneumatic tires were run up and down the runways followed by a light roller run transversely to smooth out all the tire marks. The result was a smooth resilient waterproof surface, which has held up well under very severe rain storms this summer. The runway finally set up quite hard, due to the coarse gravel which was used. Had the size of gravel been kept down to under ½ in. a softer pavement would have resulted.

Methods at Waynoka, Okla.—At Waynoka, Okla., the situation was somewhat different. The natural soil was a fine red clayey material which baked almost as hard as a brick, but slumped down immediately upon being wet. The mechanical analysis and classification were as follows:

Mechanical Analysis

Sieves, Passing	Per Cent, Individual	Per Cent, Cumulative
200 mesh	83.2	83.2
100 mesh	13.5	96.7
80 mesh	1.5	98.2
50 mesh	1.5	99.7
40 mesh	0.3	100.0

Classification

	Per Cent
Clay	57.4
Silt	25.8
Sand	16.8

The chemical analysis showed that the natural soil would take oil and that procedure was recommended. However, from a practical viewpoint it was feared that great difficulty would be found in mixing such a soil with the oil, so 2 in. of pit run coarse sand, all passing ¾-in. screen, was used in connection with the natural soil.

The sand and oil were applied as before, but while the ground was dry it was so hard that it was very difficult to get any natural soil in the mix to supply the fines. When it was wet it was almost impossible to get on the field at all and, of course, the wet soil and oil would not mix.

Finally sufficient natural soil was brought up, but it was in lumps varying in size from a small pea to a good sized marble. Numerous methods were tried to break these particles down, but all were unsuccessful. By this time the mix had been worked so much that most of the volatile oils had escaped, leaving it very dry.

It was decided to apply ½ gal. of lighter oil (50-60 per cent asphalt) to serve a double purpose. First to bring the whole mix back to a workable mass and secondly to supply an excess of oil in the runway so that as the small particles of soil broke down under traffic and wet weather there would be sufficient oil present to saturate them and cause them to become incorporated in the general mix. This procedure has been successful and the runways have stood up well under heavy rainfall. Due to using smaller gravel these runways are softer and more resilient than those at Winslow.

The methods described will work very well in the dry southwestern country. For northern and eastern fields it will be necessary to put in a much more substantial base with the plastic mix material in a layer 2 or 3 in. thick on top. The proper drainage of such fields and runways is, of course, of primary importance; however, the scope of this paper does not permit of a discussion of this subject.

The present trend in air transportation is toward larger and heavier planes, which will make the paving of runways on airports even more necessary than at present. As it has been pointed out in this paper, these runways should be of two classes, the hard surfaced taxiways and take-off strips and the softer more resilient landing areas. Asphalt oils readily lend themselves to the building of both of these types of airport paving and, undoubtedly, the members of the Asphalt Association will play a very important part in the building of the airports of the future.

Acknowledgment.—The foregoing is a paper presented at the 8th annual Asphalt Paving Conference, held Oct. 28 to Nov. 1 at West Baden Springs, Ind.

Latin-American Tour to Follow Road Show

For the benefit of members of the American Road Builders' Association who annually take a trip to the Tropics, announcement is made that such a cruise is being organized for January, 1930, by the United Fruit Co.

Their S. S. "Calamares" will leave New York Jan. 18, for a 22-day cruise, visiting Cuba, Jamaica, Panama, Canal Zone and Costa Rica. This is part of the trip recently taken by Secretary-Director Upham, in the extension work of the Pan-American Division.

This cruise affords an opportunity for road builders and their friends to add a visit to tropical countries to their trip to the Atlantic City Convention and Road Show.

Full details of the tour may be secured from Mr. W. B. Wheeler, United Fruit Company, 17 Battery Place, New York City.

Cooperative Research and Standardization of Low-Cost Road Improvement

The Need for Low Cost Roads—General Character and Limitations of the Cooperative Research—Experimental Roads in South Carolina—The California Experimental Road—The Sand-Oil Road Experiments in Nebraska

By H. S. FAIRBANK

Chairman, Research Committee, U. S. Bureau of Public Roads

WHEN E. W. James, speaking before the Seventh Annual Asphalt Paving Conference at New Orleans, called attention to the need of experiments to determine how best to use light oil products in low-cost road building, he expressed the hope of the Bureau of Public Roads that the industry would find in the development of that broad field for the utilization of its products an opportunity worthy of its best efforts equal at least to that offered in the necessarily limited field of high-class pavement construction. Examination of the program of this eighth conference, suggests that the industry approved the suggestion.

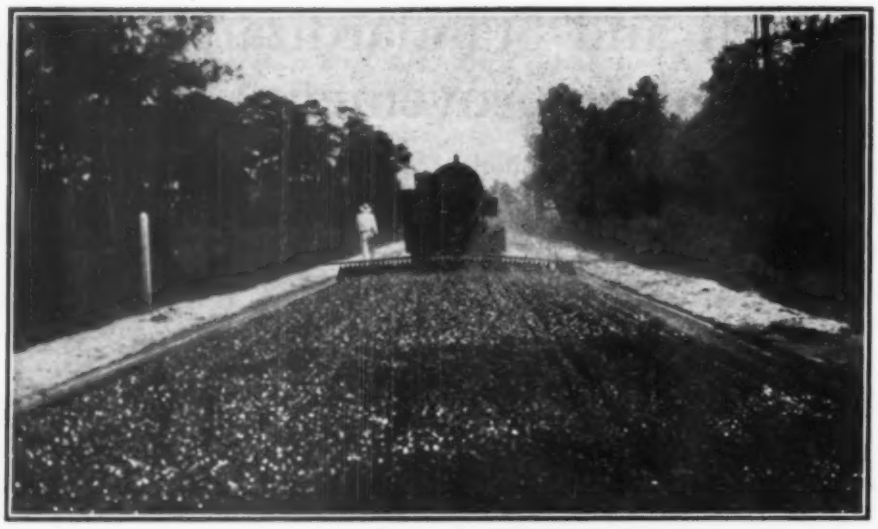
Mixing Fine-Graded Sandy Soil with Bituminous Material to Form a Base for Surface Treatment

The Need for Low Cost Roads.—The Bureau's interest in the development of methods of low-cost road construction is founded upon knowledge of the need of such methods for the improvement of literally hundreds of thousands of miles of roads on which the present traffic is of such proportions as to require a smooth, dustless, year-round surface, but not so great as to justify the necessary expenditure for a surface of high type. We have been confronted directly with this need in connection with the improvement of roads in the national forests and parks which are our special responsibility. We know that there are many miles of main roads in certain regions, particularly in the West and South, which are in need of similar improvement and we realize that the hope of satisfactory early improvement of thousands upon thousands of miles of local roads depends solely upon the prompt development of suitable low-cost surfaces.

Strengthening the Edges by Thickening and by the Use of Forms Has Reduced the Maintenance Costs of Mixed-in-Place Surfaces

The problem now presented by these local roads is much the same as that which 30 years ago was presented by the far more limited mileage of main roads. With the general increase in traffic density that has followed everywhere the mounting motor vehicle registration, we now find these local roads subjected to a traffic as heavy as that which years ago suggested the use of bituminous materials in the improvement of the main roads. The difference is that where 30 years ago the problem was to improve some tens of thousands of miles, that which now confronts the local authorities involves the improvement of hundreds of thousands of miles.

The Bureau's first active interest in experiments looking to the development of methods of low-cost surfacing using bituminous materials was an outgrowth of its experience with roads built in the national forests under its direct supervision. When traffic on these roads was considerably lighter than it now is we found the construction of a surface of finely crushed rock or gravel an adequate provision for year-round service. A similar type of surface had been adopted by a number of the Western states and a rather considerable mileage had been built when, some five or six years ago, it became apparent that traffic had already increased to a point which would demand that something be done immediately to lay the dust and



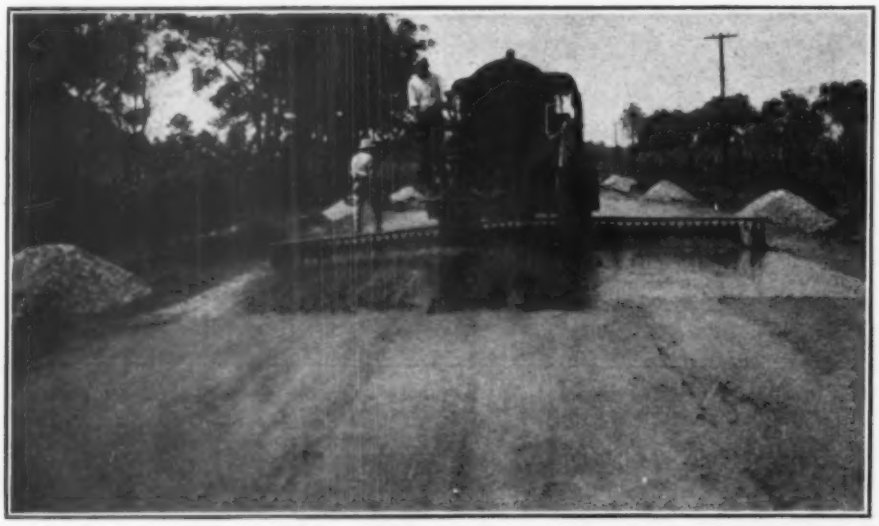
Applying Cut-Back Asphalt to Stone Prior to Mixing

reduce the heavy loss of surfacing material that was taking place.

The states of Oregon and California took the lead in the experimental use of petroleum oils by various methods to remedy the situation and when their effects had already shown some considerable promise of success, the Bureau joined with the California department in an investigation of the various methods that had been tried with a view to ascertaining what methods or combinations of methods and materials might be expected to afford the greatest measure of relief. The results of the investigation were published in 1927 in the Bureau's magazine Public Roads, and in a special bulletin of the California department.

At about the same time the Bureau was also engaged with the highway commission of South Carolina in experiments to develop the possibilities of bituminous surface treatment of topsoil roads, and the first report of these experiments, which were distinctly promising, was also published in 1927.

Methods Employed for the Elimination of Excessive Applications of Bituminous Material at the Beginning and End of the Distributor Run. The Tin Strips Are Removed Immediately After the Application of the Oil



Where Traffic Doe Not Interfere, the Prime Coat Is Often Applied for the Full Width of the Roadway

So much the Bureau had done when Mr. James made his recommendation to the industry at the Seventh Annual Conference in 1928. The suggestion met with immediate response and in March of the present year a joint technical committee was created to represent the industry and the Bureau in planning and carrying out a comprehensive study of all of the various methods which had by that time been developed in various parts of the country.

General Character and Limitations of the Co-operative Research.—It was agreed to limit the scope of the investigation to the study of the various newer methods of construction or treatment involving bituminous materials designed to produce a dustless surface resistant to light traffic and less expensive than standard penetration macadam. This would include the various methods of surface treatment of sand-clay, topsoil, gravel, stone and other materials, sand-asphalt mixtures and in-place mixtures of stone, gravel, sand, etc., with all types of asphaltic oils, fluid residuals, cut-backs and emulsions or heavier materials where necessary.

Four principal lines of investigation were projected:

1st. A rapid, but detailed study of the results of all the various methods developed locally in many parts of the country with a view to ascertaining definitely the merits of each, developing information which if promptly disseminated might be generally useful and practically applicable at once, and eventually leading to a knowledge of the principles involved in the newer methods from which to proceed to their further development.

2nd. To study the efficiency of the methods of applying and mixing asphalt and aggregates at present employed, to observe the operation of machinery

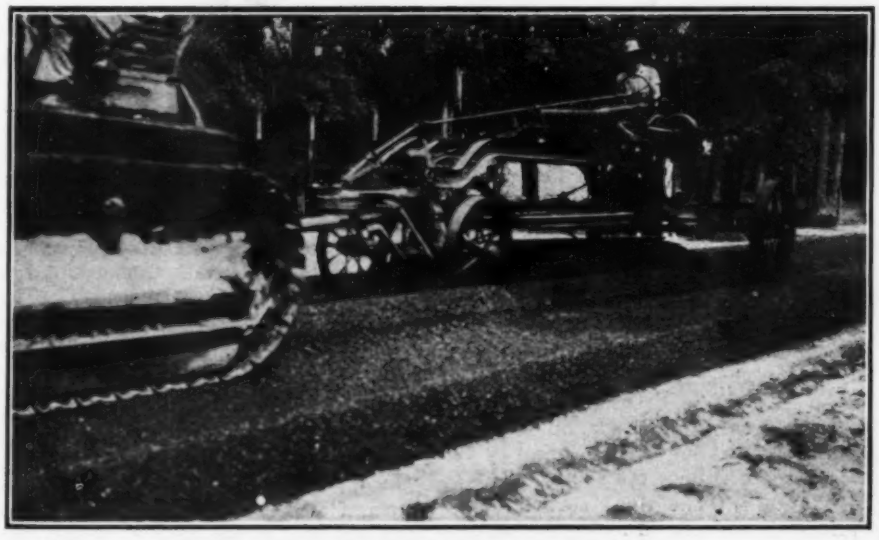
and equipment in detail, and eventually to suggest modifications in equipment and methods which might result in physical and economic improvements of construction methods.

3rd. To analyze the asphaltic materials actually used in work done to date and all available materials which might be used with a view to the development of bituminous materials having the characteristics found to be desirable for work of the various classes, and

4th. To build and study experimental roads of various types in order to isolate the effects of variables not detachable in the broader field investigations.

In the first phase of the investigation—the broad field studies—it is proposed to make a detailed analysis of the methods, materials, cost, and service of the various types of low-cost bituminous surfaces thus far developed in various localities, both by the observation of general results obtained and by the more particular study of representative sections of each type of construction with regard to which a more or less complete history is available.

The Mixing Operation Is Confined to One Side of the Roadway in Order to Make Traffic Detours Unnecessary

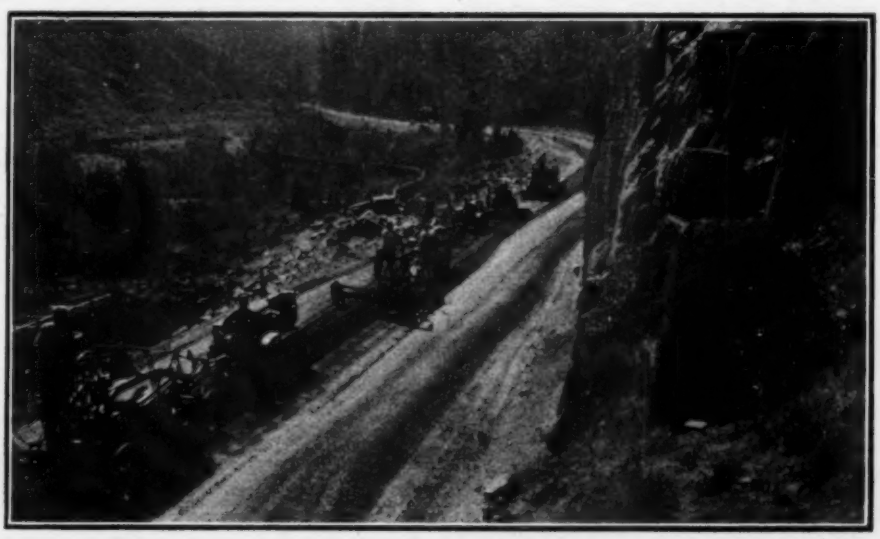


Close-Up View of Equipment Showing Method of Mixing

The types to be studied will include sand-clay and topsoil surface treatments in the Southeastern states; sand-asphalt surfaces in Massachusetts, North Carolina and other states; bituminous treatments of clay roads in Illinois and elsewhere; the retread method of Indiana and somewhat similar treatments of stone roads in other states; the so-called blotter treatment of gravel roads in Minnesota and adjacent states; oiled sand roads in California, Nevada, Nebraska, and elsewhere; and the mixed-in-place treatment of fine-crushed rock and gravel surfaces which has reached its highest development in the far western states.

Studies have already been made of surface treatments of sand-clay and topsoil roads in Florida and South Carolina; of oil treatments of clay roads in Illinois; and of the retread method in Indiana. The data gathered in the field by engineers of the Bureau, the association and the respective states, are in course of analysis at the present time; and it is expected that the first reports dealing with these three types will be published very shortly. An indication of the progress that has been made and of the general character of the information obtained will be presented by Mr. Pauls later in this morning's session.

The studies of the efficiency of construction methods and equipment, which constitutes the second phase of the investigation is being conducted by the Bureau with the advice and assistance of the association. These studies are similar in their general aims and methods to studies previously made by the Bureau in the fields of grading and concrete and bituminous pavement construction; and it is hoped that they will produce information of as great value as these other studies have brought out.



General View of Equipment Employed in the Construction of Mixed-in-Place Low-Cost Roads

Spreading Bituminous Mixtures After Completion of Mixing

They have been in progress on a number of selected projects employing equipment and methods of various types for several months; but as yet it is not possible to present any definite results or conclusions.

The third phase of the investigation —that involving a study and analysis of the available bituminous materials is the particular responsibility of the industry and is dealt with at length by Mr. Hubbard in his paper.

The fourth phase, involving the construction and study of experimental roads, has also been begun and will be actively prosecuted mainly by the Bureau of Public Roads in cooperation with several of the state highway departments, but always with the active assistance and advice of representatives of the association.

Three such detailed experiments are now in progress; the first a continuation of the surface treatments of topsoil in South Carolina; the second a series of experiments in California involving the treatment of fine crushed rock and gravel surfaces with several types of bituminous materials by methods of surface treatment and mixing in place; and the third a series of experiments in the treatment of sand soil with various asphaltic materials. The location of these experiments is the sand-hill section of Nebraska.

The Experimental Roads in South Carolina.—The South Carolina experiments have been conducted in cooperation with the state highway commission. Four experimental roads have been built in as many counties since 1925; but the first, a road in Anderson County, having served its purpose, is no longer under observation by the Bureau. A report of the experiments on this road was published in the November, 1927, issue of Public Roads.

The other three projects in South Carolina are under current observation, and constitute sources of information for the cooperative investigation. These are in Spartanburg, Horry and Berkeley counties.

The Spartanburg County project is located on State Route 19, beginning at the southern city limits of Inman and extending north to the state line. There are five experimental sections aggregating 8 miles in length on each of which the topsoil surface was given a double surface treatment, the variables being the bituminous materials and the mineral covering. On all sections the priming material was applied at the rate of ¼ gal. per square yard and the second application at the rate of 1/3 gal. per sq. yd. On the first and fourth sections the primer was a tar of 8 to 13 specific viscosity at 40°C and the second coat hot tar, the variables being the cover material which consisted of slag and stone, both graded from ¼ to 1 in. On the second the primer was a cut-back oil and the second application a hot asphalt of 150 to 200 penetration; the cover was ¼ to 1 in. stone. The third section had a prime of cut-back oil and a second coat of hot tar with covering of stone and dolomite chats; and the fifth section a prime of tar and a second coat of hot asphalt of 150 to 200 penetration, the covering stone.

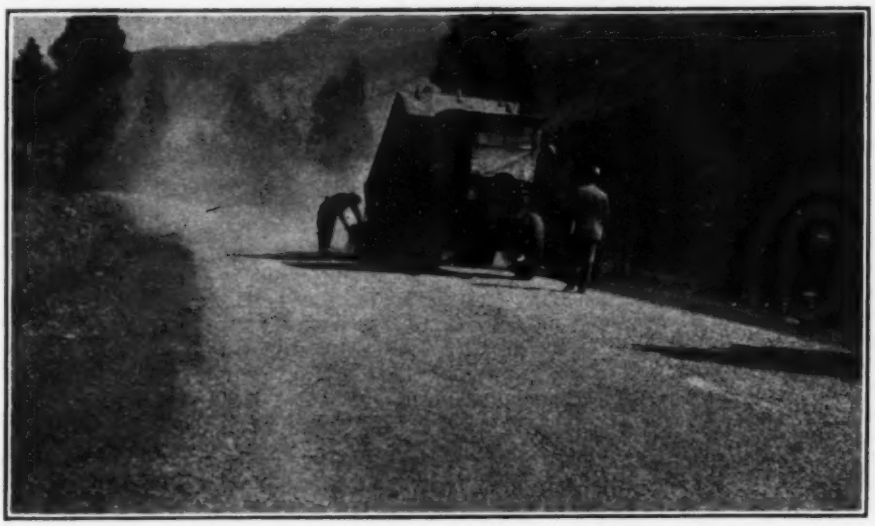
These experimental sections were built in 1925 and have since been under continuous maintenance and observation. A report of all available data up to the summer of 1927 was published in Public Roads for November of that year.

The Horry County experiments were conducted on a section of State Route 38, 20.6 miles in length, between Conway and Galivants Ferry. This project, which was a test of mixed-in-place topsoil surfaces, was constructed in 1927. There are eight experimental sections each in turn divided into sub-sections to a total of 29. Two of the sections, covering a total length of 12,700 ft., were planned to be maintained by machine. In these, four slow-curing oils were used in the mixing process and no seal coat was applied. The four oils used on these sections were as follows:

Section 3, 5,000 ft., No. 5 road oil.
Section 4A, 2,600 ft., No. 5 road oil with pressure still tar.
Section 4B, 2,600 ft., No. 6 road oil with pressure still tar.
Section 4C, 2,500 ft., Flux oil with pressure still tar.

The remainder of the sections were designed for patrol maintenance by patching. In these, various grades of quick-drying asphalts and tars were used in the mixed base and single or double surface treatments, with cover material of sand, pea gravel, crushed stone, and treated soil. One section No. 8, had only a surface treatment. The base was not mixed. It was divided into two sub-sections on one of which the primer was 85-100 penetration asphalt cut back with naphtha and on the other tar of 8 to 13 specific viscosity. On both the seal coat was 150-200 penetration asphalt applied hot. The prime applications were in the amount of approximately a half-gallon and the seal at the rate of ⅜ gal. per square yard. The cover in each case was 1¼ to ¼ in. stone in the amount of 60 lb. per square yard.

Drag Used Occasionally to Smooth the Bituminous Mixture Prior to Rolling, or During Compaction Under Traffic



Applying Cover Coat of Stone to Bituminous Surface Treatment with a Detachable Stone-Spreader Attached to a Truck

On all other sections the base was mixed with bituminous material, consisting of cut backs of asphalt of 85-100, 100-120, and 150-180 penetration, and tar of 18-25 specific viscosity; and to these mixed bases were added surface treatments of various materials, the combinations being too complex to enumerate.

As previously stated these sections were built in 1927. Since that time complete records of traffic, maintenance and all pertinent information have been kept but no report has been published. The analysis of the results obtained will supply important data for consideration in the cooperative investigation.

The third of the current South Carolina experiments is located in Berkeley County. The construction was completed during the past summer. In these experiments which have been conducted on 4½ miles of State Route 46 near Moncks Corner, we have experimented with stone surfaces laid on sand-clay and marl bases, there being 2½ miles of the former and 2 miles of the latter. Except for the length of the sections the surfaces applied over the two types of base were of the same five kinds. Four of the surfaces on each type of base were mixed in place; the fifth was surface-treated.

The objects of the surface experiments were to determine the relative value of mixed-in-place and surface-treated surfaces, and to test the practicability of using variously graded mineral aggregates with cut-back asphalts in the mixed-in-place method of construction. Consequently each of the mixed-in-place sections involves a different gradation and size of mineral aggregate. The first experiment was divided into two sections in one of which the bituminous material was a 60-70 penetration asphalt cut back with 25 to 30 per cent of heavy naphtha and in the other an 85-100 penetration asphalt also cut-back with 25 to 30 per cent of heavy naphtha. In the other three mixed-in-place experiments the 85-100 penetration material was used.

The surface-treated section on the marl base was treated with the same 85-100 penetration material in the amount of about ½ gal. to the square yard; and the same treatment was applied to a portion of the section on sand-clay base, the remainder of the section being treated with Colas.

The California Experimental Road.—The California experiments represent an effort to test under identical conditions the relative values of cut-back asphalts, emulsions, and the so-called fuel oils for surface treatment and mixed-in-place construction on fine crushed rock and gravel surfaces.

These experimental surfaces have been constructed during the past summer on a section of road about 10 miles in length near Truckee, the Bureau cooperating with the Division of Highways of the California Department of Public Works.

The section of road involved had previously been surfaced in 1927 with mixed-in-place crushed rock. The old surface had become inadequate and it was to be strengthened by addition of a new compacted depth of 3 in. of stone. Advantage was taken of this occasion to try the various bituminous materials and methods of construction.

The project includes a total of 20 experimental sections in all but two of which the mineral material is fine crushed rock, the exceptional sections being fine crushed gravel.

The bituminous treatments consisted of in-place mixtures of fuel oil, kerosene cut backs, and emulsions; and surface treatments with fuel oil, a heavy road oil, asphalt of 150-200 penetration, and two emulsified asphalts from different sources.

The Sand-Oil Road Experiments in Nebraska.—The Nebraska experiments, which have also been constructed during the past summer are located on Federal-aid project 313-A, a stretch of road about 9½ miles in length, beginning at the town of O'Neill and running south toward Bartlett. The soil at this point is characteristic of the sandy soils which occur over a large area of the State of Nebraska.

The entire project which was constructed in cooperation with the State highway authorities, is divided into nine sections each approximately one mile in length. The work just completed consisted of the construction of a mixed sand-oil surface of 4 in. compacted depth over the entire length of the road. In this work the only variable was the bituminous material of which there were three types each applied to three sections. On sections 1, 2, and 3, the material used was road oil of 60-70 per cent asphalt of 100 penetration; on sections 4, 5, and 6 an oil of 70-80 per cent asphalt of 100 penetration was used; and on sections 7, 8, and 9 the material used was a soft asphalt cement cut back with a slowly volatile solvent. Each of these materials was applied at the rate of from 3 to 4 gal. per square yard.

Mixed-in-Place Surface, with Road Oil Used as Binder, Shortly After Compaction

Next summer, when the mixed surfaces have become thoroughly compacted, it is proposed to surface-treat a number of the sections as follows:

Experiments Nos. 1, 4, and 7 are to be left untreated.

Experiment No. 2 is to be given a light application of the same oil that was used in the mix and covered as needed with the sandy soil.

Experiment No. 3 is to be given a light application of a soft asphalt cement and covered as needed with the soil.

Experiment No. 5 is to be surface-treated with the same oil that was used in the mix and covered with soil.

Experiment No. 6 will have a treatment with the soft asphalt cement and sandy soil.

Experiment No. 8 will be given the same treatment as No. 6; and

Experiment No. 9 will be treated with the same material as Nos. 6 and 8, but will be covered with gravel.

From this necessarily sketchy outline of the cooperative researches to be carried out jointly by the industry and the Bureau it will be seen that the plan contemplates:

First, a broad study of a large mileage of low-cost surfaces of the various types as constructed in all sections of the United States, with more detailed observation of certain representative sections of each type, for which the necessary historical data are available. These studies, which have been completed with respect to surface treatments to topsoil and sand-clay in the states of South Carolina and Florida, with respect to oiled clay roads in Illinois, and the retread method in Indiana, are being made by the district representatives of the Bureau and representatives of the association and several of the companies.

The second phase is the study of the efficiency of methods and equipment in use, the aim is eventually to suggest improvements in equipment and methods. This part of the work is being done by the Bureau with only incidental assistance from the association.

The third phase is the study and analysis of bituminous materials which is the special province of the association.

And finally, as a fourth phase, there are the experimental roads on which we are depending for the intensive study of materials and methods which will serve to supplement with detailed analysis the general observations made on the large mileage covered in the rapid field studies which constitute the first phase.

Acknowledgment.—The foregoing is a paper presented at the 8th annual Asphalt Paving Conference, held Oct. 28-Nov. 1 at West Baden Springs, Ind.

Completed Mixed-in-Place Coarse-Aggregate Mixture Two Inches in Thickness. The Cut-Back-Asphalt Binding-Material was Applied Cold

Street Sanitation at Milwaukee, Wis.

The Bureau of Street Sanitation of the Department of Public Works of Milwaukee, Wis., has charge of the street cleaning, ash and rubbish collection, snow removal, minor street repairs, the operation of a municipal stone quarry, and various other duties. The following information on the work of the bureau in 1928 are taken from a recently issued report, "Municipal Government Activities of the City of Milwaukee."

The bureau of street sanitation has a ward yard in each ward of the city from which the ward crews operate in the performance of the various tasks necessary to keep the streets clean, the highways open, and to dispose of emergencies which arise. These duties give employment to an average force of 200 teamsters, 675 laborers, and a considerable amount of motorized equipment.

Street Cleaning.—In cleaning streets, use is made of team hire, labor, and motor service in various ways. Seven power sweepers are kept busy most of the year. The laborers and power sweepers deposit their collections at advantageous points where teamsters pick up the refuse, and it is carried to the dump. This pick-up may be made by an ash collecting crew if there is any saving in so doing.

Business streets are cleaned daily. In such areas there are whitewings who work continuously in keeping their sections cleaned. Gutters in residence sections are swept and cleaned at least once every two weeks. Alleys are cleaned of all free rubbish by the ash collection crews in the course of their work.

The quantity of sweepings carried to the dumps was 109,766 cu. yd. Expenditures for cleaning streets amounted to $319,133.

Six power flushers generally operate a 16-hour shift in warm weather. Horse-drawn flushers are also used as conditions require them. They used over six million gallons of water, while the power flushers used over ninety-six million.

Sprinklers, operated to lay the dust when it causes distress, used 26,352,450 gal. of water in 1928.

Ash and Rubblish Collection.—It cost the city $698,142 to remove the 662,959 cu. yd. of ashes and rubbish from households during 1928. This is an increase of about 35,000 cu. yd. and $38,500 over 1927. It is probable that the shift of the population to the annexed sections accounts for the increase in service and slight increase in cost.

Four different methods of collection are employed. During 1928, increased use was made of the method of direct haul by trailer-team, which past experience has shown to be most economical. Ashes and rubbish removed from business places, the cost of which is charged directly to the firms, amounted to $23,482.

Snow Removal.—When a heavy snow storm is beginning, the snow plows are put to work immediately, keeping the main highways clear. All available equipment is taken for a few days to dispose of the snow. The expense is variable, depending upon the precipitation. Last year it amounted to $59,422.

Minor Street Repairs.—The care of all macadam and tar-macadam roads rests with this bureau. The repair work consists of fixing up cave-ins, wash-outs, breaks in pavement, settled street cuts, and raising gutters to faciliate drainage, etc. A total of $88,327, almost $20,000 less than in 1927, was expended in 1928. The major portion of this work is done through the seventh ward yard, and a special crew of laborers. Out of this yard operate the road rollers, graders, air compressors, and Andresen road repair outfits. This special crew, which is expanded to 100 men during the summer, also does most of the street oiling and the construction of drives, walks and tennis courts in the various parks and playgrounds. There were 54½ miles of street oiled at $0.1937 per front foot. About $130,000 was expended in temporary relief to annexed territory. This included the use of labor, power graders and stone and cinders used.

Bituminous Surfacing on Low Type Roads

Practice in Kentucky in Construction of Bituminous Road Mixed Treatment on Low Type Gravel or Traffic Bound Roads

By J. S. WATKINS
State Highway Engineer, Frankfort, Ky.

THE use of asphalt for the surface treatment of roads began approximately 25 years ago. In Kentucky the surface treatment of macadam roads began twelve years ago. At the time that the automobile came into use in Kentucky, approximately 20 years ago, many of the counties located in the Blue Grass section of state had a network of good macadam roads. Many of these roads were laid out and built almost 100 years ago. The counties had been able to maintain these roads in good condition for the horse and buggy traffic of the former days; but, after the automobile and truck came into general usage, these roads soon commenced to deteriorate and go to pieces, so that it was found that the old method of filling up the holes and ruts with loose napped and crushed stone would no longer maintain the road in good condition, because all such loose stone was whipped out to the roadside by the fast moving vehicles. After the first few sections of main highways were surface treated, the old method of maintenance soon began to disappear; and, with good business management, progressive improvement, and periodic surface treatment, many of these counties have preserved their entire mileage of macadam roads that were fast deteriorating and going to pieces, and today have a network of several hundred miles of wonderful county highways.

After the first surface treatment work was done in 1917 by our state highway department, it soon became apparent that every mile of macadam road could best be preserved and maintained after it is surface treated, so that our department has under maintenance today a total of 1,072 miles of surface treated macadam roads which were constructed as the water bound type.

After spending the greater portion of our revenues for a period of seven years in linking up our largest centers of population in the state with through highways of the more expensive type, we found on the first of January, 1928, that 35 counties out of the 120 in Kentucky were isolated and without means of highway communication during the winter time. These 35 counties comprise one-third of the area of our state. At that point, our department decided on the building of the greatest mileage possible of the low type surface to serve these isolated sections and get the people out of the mud. Many of these counties had less than 100 automobiles registered; three or four had even less than 15; while some of the counties in the coal fields had as many as 2,000. The policy adopted by our department was to build into these isolated sections a type of surfacing that can be improved and developed into a high type road as the section served develops and traffic increases and demands it.

On Jan. 1, 1928, we had under maintenance a total of 3,259 miles, of which, 2,695 were surfaced. On Jan. 1, 1930, at the present rate of progress on our construction, we will have under maintenance a total of 4,800 miles, of which 2,250 miles will be the so-called low type, consisting of untreated traffic bound macadam and gravel surfacing. The traffic is increasing very rapidly on these roads, and the loss of material, as well as the dust nuisance, is becoming a serious problem that must be taken care of on quite a large percentage of this mileage already constructed.

It is no longer a question with our department as to whether the traffic bound and gravel road types are a good investment, and that our policy in building these types is wise, for during the past two years we have served a total population of approximately 600,000 people, heretofore isolated and without surfaced highway connections; and this policy has met with general approval. Neither is there any further question as to the treatment of these low type roads, insofar as we are concerned, for during the past three years, we have converted 500 miles of traffic bound and gravel roads to what is generally known as high type road with a bituminous treatment, which is commonly known as retread or designated by our department as "bituminous road-mixed treatment." It is not a question now, after our experience, as to whether this treatment is satisfactory, because the service record on those 500 miles answers that question. It is now only a question of how much money can be budgeted each season to convert the low type gravel

Asphalt Cut-Back Retread Treatment on Maintenance Section 26-B in Woodford County; Applied September, 1928

and traffic bound roads into "black top high type or semi-high type pavements."

We are convinced from our past experience that, before a bituminous treatment is placed on bank or river gravel surfacing, a much more satisfactory treatment is secured where necessary replacement of floater material is made from one or more years prior to treatment, using crushed limestone of suitable size. We believe that a compacted surface of limestone from one inch to one and one-half inches adds greatly to the adaptability of the road for receiving the treatment, as well as providing a better water proofed surface and increasing the bearing value.

Method of Applying Treatment.—In preparing a section of road for this treatment, extreme care is taken to completely clean the surface of all foreign matter by the use of hand and power brooms and, in some cases, picks and shovels are resorted to in an effort to secure as much cohesion as possible between the treatment being applied and the existing surface. Following the cleaning operation, a prime application of the bituminous material adopted for the treatment, is applied at the rate of approximately ¼ gal. per square yard. Immediately following this prime application, limestone covering material, meeting the following screen analysis, is applied generally at the rate of 100 lb. per square yard.

Per cent of wear not more than	6.5
Passing 1¾ in. round laboratory screen	100%
Passing 1½ in. round laboratory screen	90-100%
Passing 1 in. round laboratory screen	30- 70%
Passing ¼ in. round laboratory screen	0- 5%

In some cases where the treatment is applied to old bituminous surfaces of various kinds, the rate of application of covering material is reduced to 70 or 80 lb. per square yard. Immediately following the placing of covering material, an application of approximately 3/5 gal. of bitumi..ous material is applied, after which the stone is turned on the road by the use of road graders or maintainers of the standard type. After the material in place has been thoroughly mixed, it is again spread over the road surface and additional bituminous material is applied in sufficient quantity to complete as nearly as possible the uniform coating of every stone particle with bituminous material. Generally for each 10 lb. of covering material 0.1 gal. of bituminous material is used. Grading is continued up to the time that the mixed material is making its initial set, at which time the entire surface is thoroughly rolled with 10-ton, 3-wheel rollers. In some instances we have found a seal application of limestone chips (¾ in. to ¼ in. size) and approximately 1/5 gal. of bitumious material necessary, principally on sections furnished by quarries which had a ready demand for limestone chips to be used in surface treatment.

Several specifications have been tried out in my state for the use of asphalt cutback material. We believe at this time that the following material has proven to be the most satisfactory.

Asphalt Cutback

Specific gravity 25° C not less than	93
*Specific viscosity at 40° C, 50 cc	125-175
Loss at 163° C, 5 hrs. 20 g	15- 25%
Penetration residue at 25° C	30- 90
Specific gravity of distillate 25° C to 170° C	70- 80
Ductility of residue after distillation, not less than	100 Cm
Total bitumen (soluble CS_2) not less than	99.5%
Percent of bitumen (insoluble in Naphtha) 86° B, not less than	15%

*Note: The department reserves the right to specify a definite specific viscosity for the above material.

In drafting a revised general specification for our 1930 construction work, we have decided to specify two distinct sizes of material in the coarse aggregate of the treatment; the first size to range from 1¾ in. to 1 in., to be sealed with chips ranging from 1 in. to ¼ in. We are quite confident that a much more uniform surface will be secured and that the danger of segregation in the covering material will be eliminated.

Cost Data.—On 222 miles of this treatment placed during the season of 1928, our records indicate an average cost of $2,600 per mile or 26½ ct. per square yard. We find that so far we have experienced very few failures, practically all of which can be charged, not against the method of application of the treatment but against faulty drainage or soil conditions in the subgrade. The maintenance costs, as shown by accurate distribution of cost on all maintenance work, compare very favorably with costs of surface treated macadam and bituminous penetration macadam surfaces.

Summary.—I feel perfectly safe in saying that, during the next construction season, we will place at least 400 miles of the low cost surface, described above, in Kentucky. Many of our main trunk-line highways are as yet being maintained as gravel or loose stone roads, and public sentiment is rapidly crystallizing alone those routes in favor of many miles of this type of surface in preference to the few miles of high type pavement which may be built with the available funds. In my judgment, the one grave danger which may arise out of treatments of this kind is that, in their desire to quickly accommodate the public, the counties, communities, and state departments will allow themselves to be persuaded into placing a road-mixed treatment before a base of proven merit has been established. Of course, there is always the question as to whether it is not more economical to apply a second treatment in case the first does not satisfactorily sustain the traffic when base failures occur. We have experienced in a very small way recently with a surface-mixed penetration pavement using stone ranging in size from 2¾ in. to ½ in., using similar bituminous materials and methods to those outlined above, and believe that

Asphalt Cut-Back Retread Treatment in Woodford County; Applied September, 1928

a more satisfactory surface can be obtained from the present method of placing standard bituminous direct type penetration pavements.

As I see the situation, many states are confronted with problems similar to those which we have and are still facing in Kentucky. With standard grade and drain construction costing at the rate of approximately $12,000 per mile; with a total revenue of approximately $15,000,000 a year, out of which probably a little more than $9,000,000 can be allotted to construction, it is very elementary that the public is demanding roads faster than a highway department with such revenues can construct them—if such construction consists only of high type pavement costing $30,000 per mile, thereby making the total cost of the road, including grading and drainage, $42,000 per mile. After all, the road should be designed to take care of the traffic needs; and the policy that our department has followed in the past two years, in building high type pavement on initial construction on the main trunkline routes and the building of the progressive or stage construction type into the undeveloped sections, has been fully justified by the results we have obtained and the service rendered to the people.

Acknowledgment.—The foregoing is a paper presented at the 6th Annual Asphalt Paving Conference at West Baden Springs, Ind., Oct. 28 to Nov. 1.

Auto Casualty Rate for First Nine Months

The automobile casualty rate for the month of September, as contrasted with other months of the year, dropped off in 1929 for the first time in years, according to recent announcement by the National Safety Council.

The combined returns from this statistical study, which included 103 cities and 11 states with a total population of 56,000,000, show that 80 persons were killed in automobile accidents daily in the country as a whole. This figure is almost exactly the same as the corresponding figure for 1928, but is more than 10 per cent lower than the figure for August of this year.

But in spite of this appreciable cut in September accidents, the first nine months of 1929 show a seven per cent increase in automobile casualties over the same period for last year.

Based upon statistical records of former years, it is expected that the coming winter months, even with the usually greatly reduced number of cars in operation during the cold season, will show only a slightly reduced casualty rate.

Poor visibility during snow storms, and during the longer hours of semi-darkness, will take its toll of pedestrians and drivers. Slippery streets, clouded windshields, and children coasting in the streets will increase the hazards.

Local Pit Gravel Production for County Road Job

Washington County, Minnesota, was fortunate some eight years ago in securing a gravel pit of excellent quality near Highway 45. Gravel was obtained at that time for the gravelling of 13 miles of road, this requiring approximately 15,000 cu. yd. Removal of this material made a deep depression in the small area purchased. No material had been hauled out of this pit for the past seven years.

When the contract was let for the gravelling of the Stillwater-Minneapolis cutoff highway, J. G. Merten, County Engineer, wishing to select a good quality of material specified that the gravel was to be taken from this pit and recommended crushing and screening.

To handle this material was a big problem but the Roth Construction Co. of St. Paul, subcontractors on this project, were equal to the occasion.

The gravel material was removed from the pit by means of a drag-line. This drag-line was operated by a hoist mounted on a truck. The other end of the drag-line was attached to a truck which served as a dead man and could be moved from place to place as conditions made it necessary to move.

The drag-line excavated the material and hauled to a trap where the larger stones, over nine inches in diameter, were removed. The gravel material falling on a belt conveyor was carried to the combination screening, crushing and loading plant. The Pioneer gravel plant No. 2 was used on this project.

A Caterpillar "60" tractor furnished the necessary power to operate the crushing and screening plant. The tractor was also used for pulling stumps and for removing the crushing and screening plant from place to place.

The hauling of the gravel was done by a fleet of 14 2½ cu. yd. International bottom dump trucks and one end dump trucks for stock piling, owned and operated by the Roth Construction Co.

The company maintained an office car and cook shanty and was equipped with its own lighting plant so that work could be done at night if necessary.

Production ran about 450 cu. yd. per 10-hour day.

The personnel of the Roth Company included J. G. Roth, president, P. C. Roth, secretary, a superintendent, a field mechanic, six additional men and 15 truck drivers, making a total of 25 men.

Roads and Streets in Haiti.—The work of resurfacing with asphalt the road from Port-au-Prince to Petionville has been completed. This work has been carried on with great rapidity and economy, having been executed within five months. The monthly output has been approximately 6,877 sq. yd., the entire area being 34,368 sq. yd. The width of hard surfacing is 18 ft. This is the first time that a road in Haiti has been paved with asphalt and the first time also that the process of asphalt treatment by penetration has been employed. With the new cross-section adopted, shoulders are provided for use by pedestrians and beasts of burden, leaving the asphalted portion free for vehicles. Standard chain-link wire guards have been placed at dangerous turns and the telephone poles along the road have been made more visible by nailing white strips to them. Center white lines have been painted on curves, and similar lines the entire length of the road will mark both edges of the pavement so as to guide vehicles and prevent as much as possible their running on to the shoulders. The entire length of the road is being planted with trees, shrubs and vines of a colorful nature in order to beautify the route, and it is expected that when these plants and trees have had two or three years' growth the road will be one of the most beautiful in the tropics.

Roth Construction Co.'s Gravel Plant on a Minnesota Road Job

Highway Location and Surveying

Pioneer Book in Field by W. W. Crosby and G. E. Goodwin

"Highway Location and Surveying," by W. W. Crosby, C. E.; D. Sc.; D. Eng.; F., A. A. S.; F., R. S. A.; M. Am. Soc. C. E., etc., and George E. Goodwin, M. Am. Soc. C. E.; Mem. Am. Assoc. Eng.; formerly Chief Civil Engr.; Nat'l Park Service. First edition, 398 pages, 5¼ in. by 8¼ in. Fully illustrated; hard cloth binding. Gillette Publishing Company, 221 E. 20th St., Chicago, Illinois, publishers. Price, $5.00.

From its inception, the suggestion of a relocation for a highway involves a regard for the existing road or routes between the same termini. Dissatisfaction with what is, breeds the idea of relocation. But what is, must itself have sprung from a cause.

"Whatever is" may not now be "best," but it is fairly certain there will be found one or more good reasons for its existence. Before determining, therefore, to make an alteration or serious relocation of a well established highway —particularly one along any questionable section of which developments are well established—it will be well to regard the facts underlying the present location, as well as the possibilities of the relocation, suggested for certain reasons, and to compare the weight of the reasons behind each as well as the advantages from various viewpoints of the alternative lines. Possibly changed conditions warrant different consideration and relocated lines for the highway, but it may be on the other hand, that they do not.

So it has seemed to the author, after many years of experience in the construction and maintenance of highway surfaces. In order to help constructively by contributing to the discussion of highway location and offering suggestions from his own knowledge and experience, he prepared the manuscript from which this book was produced.

Book One is intended to stimulate the "imagination" needed by "the successful location."

Book Two shows the "high lights" of the general subject in mountainous territories as well as furnishing practical information of great value.

Book Three is a compilation of practice, which with the Appendices containing the forms in actual use in one or more of the largest (in highway expenditures) states, shows the ways and means for translating theories into results.

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Recognition of the importance of proper location.

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BOOK III

Practical Surveying Notes.

Rough Texture Asphaltic Pavements in Europe

Wearing Surfaces Designed by European Engineers to Minimize the Shipping of Motor Vehicles

By F. J. LEDUC

Chief, Laboratory for Testing Materials, City of Montreal, Que.

THIS is rather a pretentious title for the paper I have the honor to present. It is not at present in the mind of the author to cover the whole field disclosed by this title, but rather to report notes taken while traveling through the European Continent last fall and early winter.

Seal Coats.—The practice of using seal-coats on bituminous macadam seems general, and the life of such a coat averages three years. A bituminous compound is sprayed on the surface and covered with stone chips. Near London, owing to special conditions, the material examined was a hard, well-screened gravel. The amount of it on the road exceeded that generally carried here. Even after traffic for a few weeks, the gravel kept its natural color. Although in excess, it adheres well to the road, does not form pot holes and gives a smooth driving surface, though rough in appearance.

On wood-block pavement, a seal coat is also used. Gravel is spread on it in such an amount as to form a bituminous mat. This gravel roughens the surface, at the same time entering between the fibres of the block, compressing them on the joint and sealing it, and in so doing holds it water tight.

It is not an unusual sight in big European cities in winter time to see large piles of gravel or grit on the sidewalks. These constitute the supplies from which road keepers draw once in a while to roughen the surface of their thoroughfares.

Sheet Asphalt.—Sheet asphalt is used, but a preference is now given to stone-filled sheet asphalt, in which 15 to 25 per cent of stone passing ½-in. mesh is added to the ordinary standard mix. One of the reasons for this practice is to offer to the wheels a rougher surface.

With a view to providing a roughened surface on ordinary sheet asphalt, after initial compression, and while it is still warm and in a plastic condition, it is covered with a layer of clean, hard, ⅜-in. cubical chippings, which have been previously coated with approximately 2 per cent to 3 per cent of asphaltic bitumen of medium penetration.

A third method of providing such roughened condition exists in Zurich, Switzerland, and was examined by the author. Although applied to a stone-filled sheet asphalt containing from 15 to 25 per cent of stone, I was informed, the same thing applied to the standard sheet asphalt. Since new street practice is being developed with this system, it might be of interest to describe it more fully.

The supporters of this system claim that the practice of rolling a mixture when it is hot and very plastic is wrong. They hold that compression is not properly applied by a roller. To be right, it should be exerted vertically from the bottom up, and, as it is at present impossible to do this, it should at least be from the top down.

Compression with heavy rollers in the ordinary way is not a clean vertical one, being accompanied by a longitudinal push, which action forces the material up against the places where it encounters the most resistance. It accumulates there immediately, creating centers of further disturbance, although when the work is finished this is not apparent to the eye. Traffic will simply exaggerate those defects, and the pavement, although in many cases it will not become wavy and will at least take a very poor appearance because of shadow marks. Eventually the pavement will become glossy.

To back their contentions, the European engineers have to guide them their wide experience attained in handling stamped asphalt, this type of pavement having produced remarkable examples of stability. So to achieve their ends, they resort to a somewhat different street practice than ours. Their system is as follows:

The road is leveled to the proper profile, and the hot wearing coat is well raked into place and allowed to cool. In very warm weather, this period may be from between 40 and 50 minutes, and in the late fall, when the thermometer reads around 40°, 15 to 20 minutes. Then the surface is ready to be rolled.

First a hand roller weighing around 500 lb. is passed 10 to 12 times in a direction perpendicular to the axis of the road. This first rolling is followed by a second one with a steam roller weighing from 1 to 1½ tons. It is directed in the same way as the hand rolling, and for the same number of times. Finally, cross-rolling by a 10 to 15-ton tandem roller is continued until the surface becomes cold. The traffic completes the compression of the pavement.

Enough initial compression is given by the above procedure to make the pavement waterproof, and a result of this practice is to produce a roughened surface without sacrificing the evenness of the profile. Another result is the practical disappearance of wavy effect when travelling at night or in wet weather, and it is claimed that this result will last for years.

Other contentions are made for this practice; as for example, the increase in stability, but this part is not within the scope of this paper, and is therefore omitted.

The above description is given only to indicate that a more extensive study could be made of this practice, and that departure from present American practice could possibly be made with benefit to our asphaltic pavements.

Rock Asphalt.—It would be improper to speak about European practice without mentioning roads made with the European rock asphalt. The original "stamped" asphalt has not survived, for, though it had certain decided advantages at its inception, it is now an obsolete type. It may surprise our engineers to learn that it survives only as a binder course, or possibly I should say a cushion coat.

The main objection to the "stamped" asphalt was it slipperiness, which could not be denied; but this gave rise on the Continent to a new type of asphalt mastic pavement called, even in England, "Asphalt Coule." Elaborate specifications have been developed to cover the construction of this type, and I know of no better than the one from "Direction Administrative des Travaux," Ville de Paris, 15 Avril, 1915.

The "stamped" asphalt was produced by first pulverizing the natural rock meeting certain specifications, heating this product in kettles to 275°F., and raking this mass on the street and tamping it, while still hot and compressible.

To produce "Asphalt Coule," it is necessary first to produce at the mine a uniform product, and blocks weighing around 100 lb. are cast. They are made by heating the pulverized matter with added bitumen, so that the blocks will have a final content of around 15 per cent of bitumen. These blocks are shipped to the different contractors, who make the final preparation in kettles provided with mechanical agitators. An example of a formula used will best illustrate the procedure, so here is a typical formula for street work:

		Per Cent
Prepared rock asphalt mastic	100 kegs	59.17
Added asphalt	4 kegs	2.37
Added stone	65 kegs	38.46
	169 kegs	100.00

This will give a final bitumen of around 11.3 per cent.

The rock asphalt blocks and the asphalt are first introduced into the kettle, and when these are melted to-

gether, the hot stone is added. The heating operation lasts approximately seven hours. The product is then loaded in locomobiles provided with mechanical agitators, and sent in them to the streets, where the material is floated into place and left to cool without any further compression.

To increase the anti-skid property of the pavement, steel bars ½ in. thick are placed in V-formation, spaced about every 5 in., where they are left for a while. When taken out, they leave ridges about ¼ in. deep. Those ridges were originally expected to last 3 years, but it is now evident that they will last for a much longer period.

Another system for increasing the anti-skid property is the passing of an indented hand roller on the surface, leaving holes in the pavement. Such holes have lasted for over 4 years on a medium traffic street.

This type of pavement has a natural stability that keeps the mixture from flowing to fill the indentations in its surface.

We cannot close this rapid survey of European roughened surfaces without mentioning the fact that a type of pavement has been produced in Europe since five years ago, based on a new conception of the function of the asphalt cement in a paving mixture. In this case the asphalt is no longer considered as a binding material, but as a lubricant. Enough asphalt coats the aggregate, which of course is a fine, well-graded one, to exclude moisture and facilitate its movement in the mass. It is only lightly rolled, and in many cases only tamped. The traffic gives to the material its final compression.

It is a very stable pavement, unaffected by the atmospheric agents; and the surface is even, but with a rough texture. Very unfortunately the author of this paper had not the time to make a complete study of this type, but it looked to him very promising. A complete investigation of it might be of some great interest to the asphalt technologists as it indicates drastic departures from ordinary conceptions.

Acknowledgment.—The above is an abstract of a paper presented at 8th Annual Asphalt Paving Conference, West Baden Springs, Indiana, Oct. 28 to Nov. 1, 1929.

Eastern Highway Officials to Meet at Syracuse, N. Y.—The 1930 convention of the Association of State Highway Officials of the North Atlantic States will be held Feb. 19-21 in Syracuse, N. Y.

Samuel Eckles, Chief Engineer of the Pennsylvania highway department, was elected president of the Association in a mail ballot last month. George H. Henderson, Chief Engineer of the Rhode Island State Board of Public Roads, was elected vice-president, and A. Lee Grover, Secretary of the New Jersey state highway commission, was re-elected secretary-treasurer.

Railways Substitute Highway for Rail Transportation

One of the notable motorcoach transportation developments promoted by a steam railroad, according to Frederick C. Horner, speaking before the Transportation Meeting of the Society of Automotive Engineers in Toronto, is that of the New England Transportation Co., operating over 61 routes covering 2,200 route-miles in an area of approximately 30,000 square miles. The company is a subsidiary of the New York, New Haven & Hartford R. R. and, according to the officials of that company, has been very successful from the standpoint of revenue production as well as in reducing losses on unprofitable passenger trains by using a motorcoach as a substitute for or to supplement the trains.

This railroad motor-transport company operates more than 300 motorcoaches and employs 500 men. In 1928 it operated 9,000,000 motorcoach miles and anticipates that it will do 10,000,000 miles in 1929. It carried 5,500,000 passengers last year and expects to carry 6,500,000 this year. The motorcoaches operated 96 per cent on time in 1928, and the cost of operation was 29.3 ct. per coach-mile. Fifty motorcoaches are operating between Boston and New York City, a 240-mile run, carrying 500 to 600 passengers per day. On the 40-mile run between Boston and Providence, R. I., this company's motorcoaches carry 900 passengers per day.

Another large railroad serving the New England section of the United States, the Boston & Maine, has extensive motortransport operations. Its subsidiary, the Boston & Maine Transportation Co., in addition to its motortruck services, operates 111 motorcoaches and, by the substitution of them for unprofitable trains, estimates the savings of the railroad at $500,000 per year.

The Boston & Maine R. R. has followed a formula or plan of substitution of highway for rail transportation, which is summarized as follows:

1. Complete substitution of motorcoach for steam-train branch-line passenger service.
2. Partial substitution on branch lines.
3. Partial substitution on main lines.
4. Complete substitution for electric railways owned by the Boston & Maine R. R.
5. Complete substitution for electric railways not owned by it.
6. Motorcoach operation to supplement steam-railroad passenger service.

This grouping is based on the relation of the motorcoach to rail passenger-service.

A new and more convenient way of carrying passengers to and from the center of New York City, was inaugurated on Aug. 29, 1926, by the Baltimore & Ohio R. R. This innovation was typical of the pioneer achievements of America's first railroad and of the vision and leadership of its president, Daniel Willard. Under the new arrangements, the Baltimore & Ohio trains terminate their runs on the west bank of the Hudson River at the main station of the Jersey Central R. R., in Jersey City, N. J., from which point the Baltimore & Ohio special parlor motorcoaches transport passengers through the business, shopping, hotel and theatrical districts of Manhattan without extra charge.

Commodious and comfortable motorcoaches which provide individual seating for each passenger and space for hand luggage, run directly from the train-side at Jersey City by way of ferry to lower Manhattan and thence to the Baltimore & Ohio motorcoach terminal in the Chanin Building on 42nd St. in the heart of New York City, just opposite the Grand Central Station. Sub-terminals at which these motorcoaches make regular stops are located at strategic points on the routes followed.

The terminal at the Chanin Building is the most modern design of motorcoach terminal in the world. The coaches are driven into the building on the ground floor, just as a train enters the train shed of a modern railroad terminal. After discharging the passengers, they are turned on electrically-operated turntables, and in a few minutes are ready for a return trip to the rail terminal at Jersey City.

New Section to Study Traffic

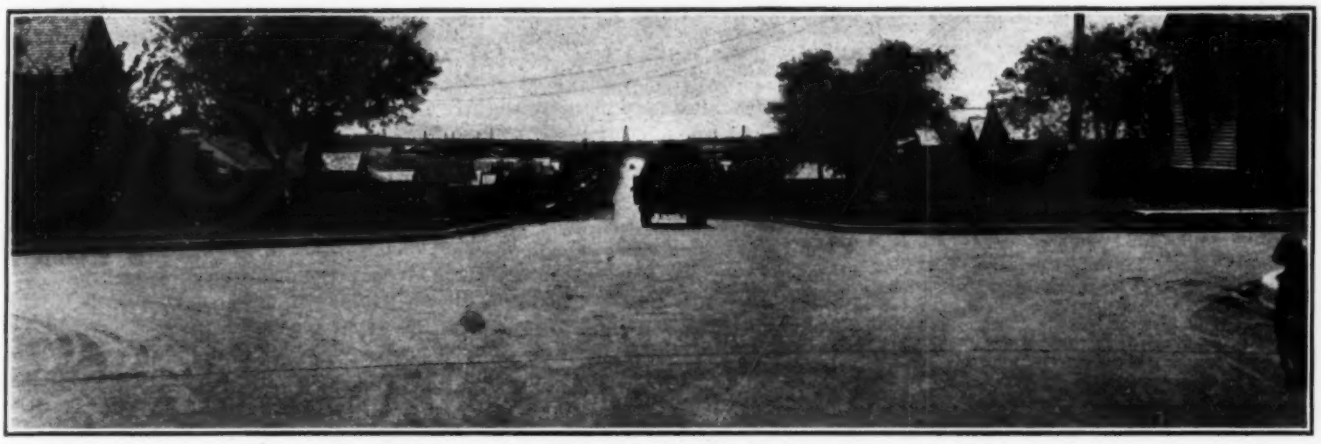
Organization of a new Street and Highway Traffic section of the National Safety Council with Professor August Vollmer of the Department of Police Administration of Chicago University, as its chairman, has been announced.

This new division of safety work is a direct outgrowth of the Eighteenth Annual Safety Congress, held in Chicago from Sept. 30 to Oct. 4, when several hundred specialists in the field of public management assembled from all parts of the world.

Using Chicago streets as a laboratory, they made traffic tours and considered plans toward the promotion of city uniformity in traffic regulations and handling.

Through interchange of information this new section of the National Safety Council expects to promote safe and uniform regulations in the local communities of its members. Studies of traffic accident causes and remedies will be made and circulated with the plan of reducing local hazards.

Working with Professor Vollmer, as vice-chairman of this section, will be Clifford J. Davis, Vice-Mayor and Commissioner of Fire and Police, of Memphis, Tenn.; and Captain George A. Parker, Registrar of Motor Vehicles of Massachusetts.



West Williams St., Breckenridge, One of This City's Newly Constructed "Black Base" Pavements

Asphaltic Concrete on "Black Base"

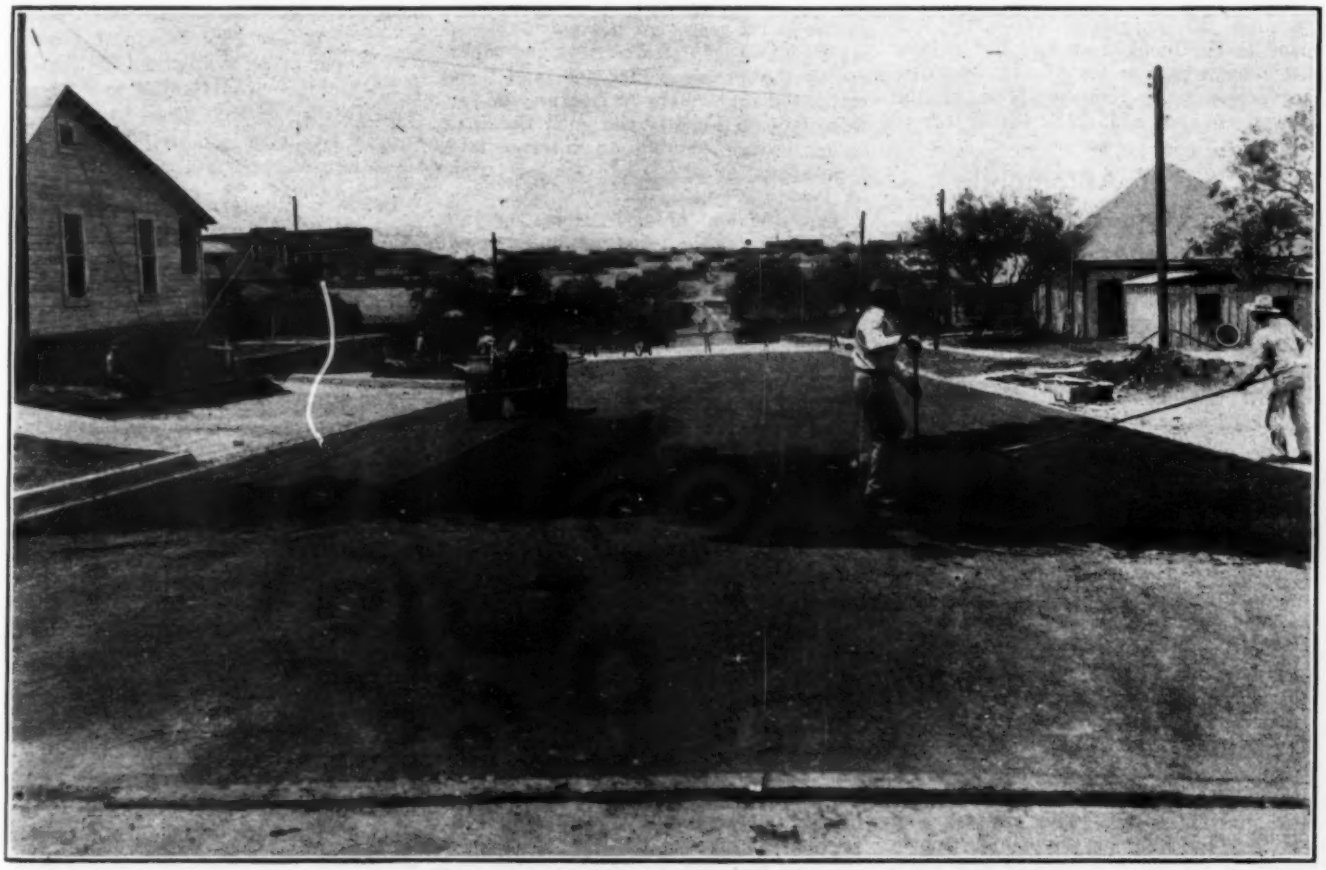
How a Texas City Paved Its Streets

By A. D. STIVERS
Engineer, The Texas Company

BRECKENRIDGE is the county seat of Stephens County, Texas. When oil was discovered in Stephens County in 1918 the population of Breckenridge was about 800 and the nearest railroad was about 35 miles away. Breckenridge is now a thoroughly modern city with three railroads, modern hotels, many miles of paved streets, and a population of about 12,000. Stephens County is still producing large quantities of high grade oil and Breckenridge pavements carry a heavy oil field traffic as well as an ordinary city traffic.

Breckenridge's first pavements were brick with asphalt filler and asphaltic concrete on a portland cement concrete base. These pavements have given excellent service for from four to six years and are in excellent condition today. In 1927 a small yardage of asphaltic concrete surface on asphaltic concrete or "black base" was laid. This was laid on an old gravel street which was reshaped and surfaced with 2 in. of asphaltic concrete on a 2½-in. black base.

This street gave such excellent service that in 1928 when Breckenridge let contracts for 50,000 sq. yd. of pavement, asphaltic concrete surface on a "black base" was selected as the standard pavement. Only a small yardage of the streets to be paved were already surfaced with gravel. On this portion



Smoothing and Rolling the Asphalt Wearing Surface of the "Black Base" Pavement. The Workman on the Right Is Using a "Lute" to Supplement the Hand-Raking of the Asphalt Mix

of the pavement a 2½-in. black base was used. On residence streets where there was no gravel 3½-in. black base was used. On some very heavy traffic business streets a 5-in. black base was used. The thickness of the asphaltic concrete wearing surface varied from 1½-in. to 2-in., depending on the anticipated traffic. All the pavement was laid under the supervision of C. C. Todd, City Engineer, and L. W. Pelphrey & Co. of Breckenridge. Texaco No. 54 paving cement was used in both wearing surface and black base.

Two features in the construction of this pavement are a little out of the ordinary.

The asphalt plant was located at the rock crusher and the asphalt was hauled from the railroad to the plant. The crushed rock was carried directly to the bins in the paving plant by bucket conveyors. As the asphalt was only about 7 per cent of the total mixture, most of the balance being crushed rock, this effected a material saving in haul, the rock crusher being located at a point near the streets to be paved.

The second unusual feature was that almost no sand was employed in the asphalt mixture. There is an abundance of good limestone in and near Breckenridge, but sand must be shipped in at a comparatively high price. A pulverizer was installed at the rock crusher and most of the sizes in the asphalt mix usually found in sand were produced by running the crushed rock through this machine. No sand was used in the black base and but a very little from time to time in the wearing surface when screen analysis of the aggregate showed it to be necessary.

Cost of Automobile Operation

Further proof that good roads are a paying investment from the highway user's point of view is shown in an analysis of automobile operation costs on various types of highways now being studied by the highway finance committee of the American Road Builders' Association.

The average automobile owner may prefer not to know what his per mile operating cost actually amounts to, but he is surely interested in knowing how much he saves by driving on improved roads, also the difference in cost of operating various types of cars and the savings accruing in each case as the result of highway improvement.

Data used by the committee is obtained from many sources, much of it furnished by Agg and Carter.

Tractive resistance, which amounts to 2,000 lb. per ton when a car is mired, is quickly reduced by improved roads, the analysis shows. This resistance of the surface against the vehicle movement is figured for year-around operation at an average 35-mile speed, as follows:

	Lb. per ton
High type (paved surfaces)	70
Intermediate type (treated surfaces)	110
Low type (soil and gravel surfaces)	160

Wind resistance may increase slightly the actual cost of operation on the good surfaces, as the natural tendency of traffic is to maintain a higher speed there, effecting a saving of time but adding to the wind resistance.

The average relative gasoline consumption, determined from reported engine tests and actual measurements on the road, showed that where a vehicle will travel 15 miles to the gallon on a high type surface, it will require 1.2 gal. of gasoline on the intermediate type and 1.47 gal. on the low type road surface for the same distance.

From detailed cost records reported on about 800 automobiles operated in various parts of the United States, figures were prepared taking all factors into consideration, showing the average cost of automobile operation over all types of surfacing to be in cents per mile:

	Ct. per mile
Light Fours	6.02
Medium Fours	6.42
Heavy Fours	7.20
Light Sixes	7.38
Medium Sixes	8.40
Heavy Sixes	9.45

Among the various items of operating cost, road condition is shown to have no effect on license, garage, interest and insurance. The increase in cost of maintenance and in depreciation of automobiles as the type of road becomes poorer is in somewhat the same ratio as the increase in gasoline consumption, shown above. In cost of tires and tubes comes the greatest increase, and it is estimated that where $1 is expended for this item on high type roads, the cost is more than double on intermediate type roads, or $2.22, and almost triple on low type roads, or $2.90.

The division of cost items on an imaginary "average" automobile, based on annual mileage of 11,000, is shown as follows:

Item of cost	Ct. per mile
Gasoline	1.31
Oil	0.22
Tires and tubes	0.64
Maintenance	1.72
Depreciation	1.39
License	0.24
Garage at $4 per month	0.44
Interest at 6 per cent	0.36
Insurance (fire, theft, tornado)	0.21
Total cents per mile	6.43

The saving shown in operation of such average automobile due to road improvement is, where low type roads are changed to intermediate type, 1.07 ct. per mile; where intermediate type is changed to high type, 0.99 ct. per mile, and where low type is changed to high type, 2:06 ct. per mile.

The cost tables range from 11 ct. per mile, the cost of operation of a "heavy six" over low type roads, down to 5.10 ct., the cost of operating a "light four" over high type roads. This gives a conservative figure for the lightest car and the best road conditions obtainable, and for the heaviest car operating on low type roads.

Traffic Survey Now Under Way in Western States

In order that the Federal Government and the Western States may know what the flow of traffic is throughout the year on the main transcontinental highways and on other roads in the Federal-aid highway system in the West, the highway departments of Washington, Oregon, California, Idaho, Nevada, Wyoming, Utah, Arizona, Colorado, New Mexico and Nebraska and the Bureau of Public Roads of the United States Department of Agriculture began a traffic survey in September which will extend over a period of one year. Among the routes on which traffic will be measured are the historic Oregon Trail, over its entire length from Omaha to Portland, parts of the Santa Fe and Overland Trails, and the long-distance motor-bus routes from Omaha to Denver, Salt Lake City and San Francisco, and from Denver to Los Angeles by way of Santa Fe, and from Seattle to Los Angeles.

Data compiled by the State highway department of New Mexico in 1927 and 1928 indicate that more than 30 per cent of the vehicles using the roads of that State in those two years were from other States, and on many routes the so-called "foreign" traffic was more than half the total. The foreign traffic on many of the New Mexico highways was 50 per cent greater in 1928 than in 1927, and the total traffic was 22 per cent greater in 1928 than in 1927. A similar situation is believed to exist in the other Western States.

In these Western States traffic has reached the point where it is necessary for the States to know the flow, density, and composition of the traffic on their roads, so they can plan their highway systems on a good economic basis and plan for the removal of snow in winter.

The survey will show the number of vehicles using each of the main highways throughout the year, by days of the week and hours of the day, and the number of vehicles passing a given point at certain times of the day. It will classify the traffic according to types of vehicles, whether passenger cars, motor trucks, or motor busses, and the number of passengers in passenger cars. The importance of cities, towns, and sections of the State as the source and destination of traffic will be ascertained, and the number of vehicles from other States using the highways, and other information required by State and Federal highway officials, will be obtained. The data will be useful in solving traffic regulation and safety problems. Surveys are being conducted simultaneously in each of the States.

Tractor and Construction Equipment Lines Announced by United

A complete line of tractor powered road building and construction equipment has recently been announced by the United Tractor & Equipment Corporation, 612 North Michigan Ave., Chicago, Ill. This organization, it will be recalled, was formed over a year ago by a number of well-known equipment manufacturers and distributors who have since been busily engaged in the development of their equipment lines.

The United industrial tractor, around which all the operating equipment is designed, is built by the Allis-Chalmers Mfg. Co. at their Milwaukee plant. To make the tractor available for the widest possible range of work it is furnished either as a rubber tired or crawler tractor unit.

Included in the United line are: the rubber tired industrial tractor, the crawler tractor, road graders and rollers, snow plows, power shovels, "iron mules," scrapers, bulldozers, backfillers, loaders, hoists, arc welders, cranes, pipe-handling booms, locomotives, stump-pullers, trailers and street sweepers. A representative showing of the line will be made for the first time at the Atlantic City Road Show in January.

The United Tractor combines unusual power with light weight and sturdy, compact construction. Among other features claimed for it: are great power at all engine speeds, ease of handling and economy in operation. Frameless, single unit type of construction with three-point suspension is employed, with all gears and working parts enclosed.

The power plant is a heavy duty 4-cylinder engine with a 4½ in. bore and 5 in. stroke. Under full load the engine speed is 1200 r.p.m. and is under built-in governor control. A gear driven oil pump with leads to all main bearings, connecting rod bearings and piston pins provides full pressure lubrication.

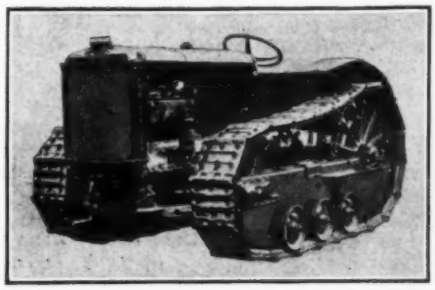
The United Center Control Grader—A One-Man Unit Built by Wehr Co. and Powered by the United Tractor

The engine is protected against dust by a double action air cleaner and an oil purolator.

The transmission is of the automotive unit power plant type, and provides four forward speeds and reverse. Speeds available at normal engine speed are 2 1/3, 3 1/3, 5 and 10 miles an hour.

Several thousand United tractors are in actual use in various fields, including a number in the service of state highway departments. The design of all operating equipment for the tractor embodies proven features developed over a period of years by the individual manufacturers of the corporation.

Included in the list of corporation members manufacturing United industrial equipment are: Allis-Chalmers Mfg. Co., Milwaukee, Wis.; Brookville Locomotive Co., Brookville, Pa.; Detroit Harvester Co., Detroit, Mich.; Dorsey Bros., Elba, Ala.; Maine Steel Products Co., South Portland, Me.; Muskogee Iron Works, Muskogee, Okla.; Northwestern Mfg. Co., Milwaukee, Wis.; Perry Co., Sidney, Ohio; The Hughes-Keenan Co., Mansfield, Ohio; Trackson Co., Milwaukee, Wis.; Universal Power



The United Crawler Tractor—a Joint Product of Allis-Chalmers and Trackson Co.

Shovel Co., Milwaukee, Wis.; Wehr Co., Milwaukee, Wis.

The sale and service of United tractors and equipment is handled through distributing members of the Corporation and their affiliated dealers.

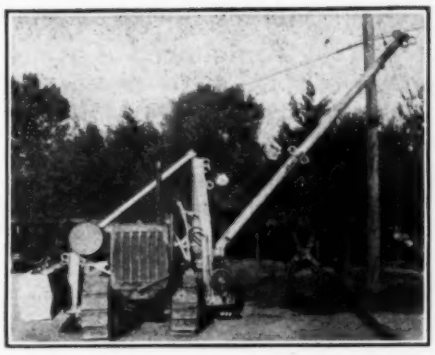
Boom Attachment for Tractors

A new boom for attachment to caterpillar tractors has been brought out by the W-K-M Co., Inc., Houston, Tex.

The equipment is applicable to "Caterpillar" tractors, Models Twenty, Thirty Standard, Thirty Hillside Special, and Sixty. Field installation is very simple and two men can very easily attach the unit for the first time in approximately four hours. The unit fits all the models specified above and it is not necessary that a new tractor be purchased along with the boom.

One of the outstanding features of the boom is that its application in no way hampers the use of the tractor on drawbar work. In addition, besides being able to handle large loads with ease, it can also be operated in conjunction with a clamshell bucket, dragline bucket, throwout bucket, lifting magnet, etc.

The unit utilizes the power generated by the tractor. A lateral boom swing of 160 degrees is obtained through the



W-K-M Boom Mounted on Caterpillar Thirty Standard Tractor

use of two small swing drums. In addition, a low speed and a high speed winch are also provided, either drum of which can be changed in a very short time to obtain the same speed in both winches.

The method of attachment is very simple. No drilling or cutting of any kind is required. Four clamps are provided, two being attached to the track roller assembly on each side of the tractor. The winch and boom mechanism are mounted on a heavy channel shelf which is attached to the clamps on the left hand side of the tractor by means of pins. A counterweight shelf provided for attachment to the right hand side of the tractor, is fastened in the same manner. This method of attachment permits quick assembly, or disassembly provided it is desired to take the equipment from the tractor.

Power is obtained from the rear of the tractor by means of a specially designed power take-off unit and is passed to the main shaft through means of heavy chains. This main shaft is of high grade steel, accurately machined and is provided with large size keyways to prevent shearing or rolling of keys. The main bearings are of babbitt while the countershaft and drum bearings are of bronze.

Clutches are of the internal expanding type 17½ in. in diameter. The shoes are faced with composition lining which can be renewed easily without removing or disturbing other parts on the shaft.

Only the best grade of steel castings is used throughout. "A" frames are provided on each side of the tractor, connected by a cross brace, thereby eliminating all strain on the track roller frames and final drive bearings. In order to overcome the strain on the equipment through the track oscillations, the manufacturers have provided ball and socket joints wherever necessary.

A collapsible boom is provided having a normal length of 13 ft. When extended it has a length of 25 ft. The diameter of the outside pipe is 5 in. and that of the inside 4 in. This is true of the model for attachment to the "Caterpillar" Thirty. The boom for the "Caterpillar" Sixty has a boom extension of 35 feet.

New Small Crawler Crane Announced

The Ohio Locomotive Crane Co. of Bucyrus, O., manufacturers of Ohio railroad type of cranes, have now placed on the market a ⅜ cu. yd. crawler type of crane and excavator, incorporating therein some of the outstanding features in design and construction characteristic of the Ohio cranes.

New Crane and Excavator

All of the castings used on this small machine that require strength are made of cast steel. The machinery base, side housings, roller path and rack and the large frame in carbody are each made of a large steel casting that will withstand all severe shocks and strain without any alarm for breakage.

All shaftings are made larger in diameter than what is actually required, of high grade steel, accurately machined, ground to exact size, and provided with large size keyways to prevent shearing or rolling of keys. All shafts revolve at slow speed, the highest being 68 rpm. Slow speed shafts will not require frequent lubrication, nor will they cause the bearings to heat.

All bearings are made of high grade bronze and easily renewed. The wearing surfaces of all thrust bearings are separated by bronze washers.

All gears are made of steel and the ones in continuous operations are made of high carbon forged steel provided with cut teeth and wide face.

The clutches used are of the internal expanding type 18½ in. in diameter. The shoes are faced with composition lining which can be easily renewed without removing or disturbing other parts on the shaft. All of the clutches employed are of the one size and all such parts are interchangeable.

An International gas power plant is used which develops 30.4 hp. at 1,000 rpm. This crane or shovel is capable of making six complete revolutions per minute. For shovel operation the boom is of the box girder design, provided with outside dipper handles. A boom hoist operated by power is provided for on all machines as standard equipment.

The operating levers, of which there are three, and the hydraulic brakes are controlled from the operator's seat and arranged within easy reach to allow full operating efficiency with minimum effort.

A fully enclosed cab of heavy sheet steel is provided with adequate windows and doors. A method is employed whereby all fumes and hot air from the motor are drawn from inside the cab, instead of being forced upon the operator.

The tracks are made of cast steel and adjustable from either end, allowing the removal of a shoe in case of breakage. The tread side frames are made in one piece steel casting.

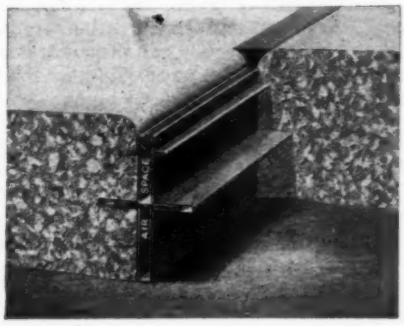
This machine is easily converted from a shovel to a crane and vice versa. When furnished as a crane it will be equipped with a 30-ft. parbolic steel boom to handle a ½ cu. yd. clamshell bucket. A longer boom can be used when required. When furnished as a shovel, it is equipped with a 16-ft. length of boom equipped with a ⅜ cu. yd. steel dipper provided with bucket teeth.

Truscon Develops New Expansion Joint

A new expansion joint called the Air Cushion Joint recently developed by the Truscon Steel Company consists of metallic sides forming a free air space for expansion. This space is closed at the top by a bellows-shaped piece of galvanized, copper-bearing steel which prevents dirt working into the joint from the surface of the pavement.

A dowel plate in their Type A joint, which is continuous from curb to curb is incorporated in the joint by an arrangement which permits all necessary expansion and contraction movements without losing its effectiveness in keying together the adjacent slabs of pavement. In the Type B, the joint is manufactured without the dowel plate, and is punched to receive dowel bars.

Advantages of the new Air Cushion expansion joint as pointed out by its manufacturers are that it is quickly and accurately placed, that it permits all necessary expansion and contraction of the paving without impairing the surface, that it does away with the tendency of incompressible soil to fill opened contraction joints, since only air is squeezed out of this joint and only air can fill it, and that it does not



Type B Expansion Joint as Announced by Truscon

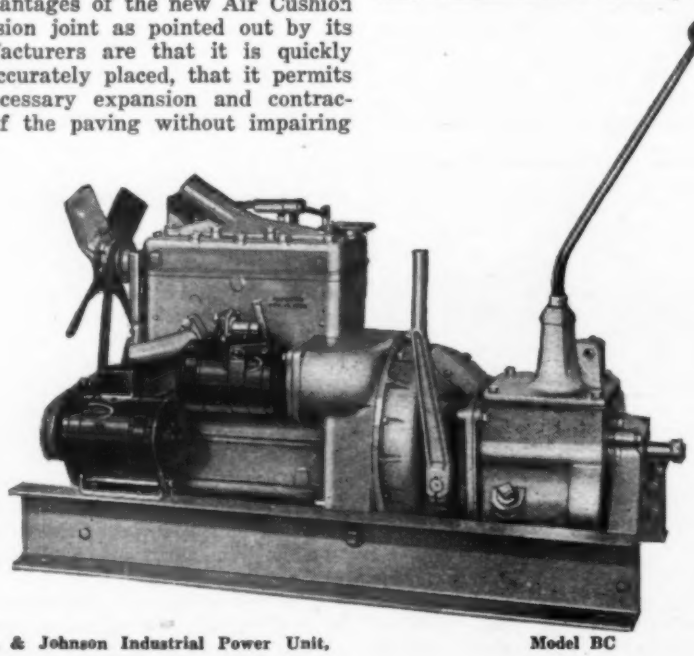
interfere with the normal spreading, rolling, floating or belting operations incident to paving construction.

The Air Cushion expansion joint is being manufactured in the Truscon factory at Youngstown, and will be sold in lengths up to six ft. by Truscon branches.

Variable Speed Industrial Power Unit

A Fuller & Johnson, four-cylinder, model BC, 6-10 hp. industrial power unit with variable speed transmission, three speeds forward and reverse, has just been announced. The fully enclosed dry disc type clutch is mounted on the main shaft operated at engine speed. The clutch can be equipped with hand lever or foot pedal.

This unit is ideal for operating industrial trucks, small excavating machines, conveyors, small tractors, and other jobs where variable speed is essential. The transmission is sturdily built and



Fuller & Johnson Industrial Power Unit, Model BC

permits continuous operation in first and second gear without undue strain or wear on the working parts.

This model BC engine can be equipped with a smaller transmission for use where continuous operation in first or second gear is not required. It is equipped with an electric starter of the automotive type.

The illustration shows the compact assembly of the generator and starting motor. The generator charges the 6-volt battery which supplies current for the starting motor and also for lights on the machine. The manufacturer states it is simple, compact, easily accessible and efficient.

The Fuller & Johnson two-cylinder, model BB 3-5 hp. and the Fuller & Johnson four-cylinder, model AX 20-25 hp. power units can be furnished with variable speed transmission and electric starter.

The Ricardo head insuring greater fuel economy and maximum power is standard equipment on Fuller & Johnson vertical engines, models ABR, AH, AX, BB and BC.

Mohawk Produces Steel Tool Box

The Mohawk Asphalt Heater Co., Schenectady, N. Y., has recently put on the market a new trailer tool box, described as the "last word" in modern equipment for the progressive contractor, railway, and municipal gas, water and electric light department.

This equipment, which consists of a steel tool box made of 11 gauge steel with hinged, waterproof covers, not only provides a speedy means of transporting tools from job to job, but can be left on the job over night, its covers locked down and the tools protected from tampering and theft. Its use frees the truck used for transporting tools for other jobs. Equipped with vise and pipe rack it makes a very efficient work bench. It is provided with positive non-slip supporting legs, front and rear.

Mohawk Portable Steel Tool Box

The tool box, which measures 3 ft. wide by 7 ft. long, and 24 in. deep at the peak, is mounted on a heavy, 3-in. one-piece frame and draw bar, fitted with draw eye and amply reinforced. It has heavy duty semi-elliptic springs. The axle is of hollow steel, and is fitted with 2½-in. by 7-in. roller bearings. Wheels are of steel, with 30x3½ Firestone cushion tires. All bearings are fitted with Alemite grease connections.

The tool compartment is reinforced inside with angle irons, and has a sliding tray 12 in. wide the length of the box, which is partitioned off for small tools and fittings.

Slide bar lock for locking both covers and front supporting with one lock is provided as extra equipment. Wheel and tire lock bars, 6-in. rubber-tired swivel casters, etc., may also be had at slight additional cost. Special sizes can be made to individual specifications.

The Mohawk Hi-Speed trailer tool box was designed to replace the old wooden box, or the makeshift boxes now in use by many contractors. It offers convenience, safety, speed and years of efficient service to its owner.

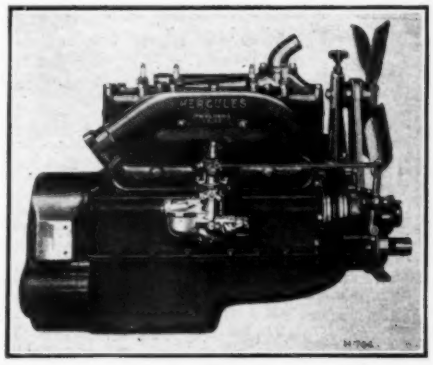
Hercules Engine Developed for Heavy Duty

To meet the growing demand for heavy-duty power in the lower horsepower ranges, the Hercules Motor Corporation of Canton, O., has developed the "OO" Series of 4-cylinder engines. Built in three models, the "OO" Series engines embody the characteristic of the famous Hercules "OX" Series engine, of which they are smaller counterparts. The "OO" engines are not designed for a single purpose, but are completely developed for universal application.

The "OOA," "OOB" and "OOC" models, which comprise the "OO" Series, have bores of 3½, 3¾ and 4 in., respectively, and a common stroke of 4½ in. They are identical in general design and the majority of the parts are interchangeable among the different models, the only difference being in the bore sizes and the parts affected thereby. All the models develop maximum torque at 1,000 rpm. and peak at 2,200 rpm.

To meet present day operating conditions calling for sustained high speed, special consideration has been given to valve cooling. The water is conducted from the water pump directly across and through the block and distributed into a passage immediately between the valves and the cylinders. The valves are thus completely surrounded by water. As a further aid to valve cooling, the valve guides are brought up very close to the valve heads, to more quickly dissipate the heat absorbed in the heads.

Lubrication is full force feed. The pump is located beneath the center main bearing and driven from the camshaft by spiral gears. The shafts and gears of the oil pump are case hardened, insuring long life to this unit. Oil pressure can be adjusted easily to suit operation requirements. As in all Hercules engines, the "OO" Series models have the crankcase cast integral with the block. The connecting rod bearings are 2 in. in diameter and 1½ in. long.



Hercules Heavy Duty Engine "OO" Series, Manifold Side

The pistons are of cast iron and carry three rings above the pin. The lower of these rings is an oil regulating type. The rings of all the "OO" engines are 3/16 in. wide with a turned face that operates on the smooth surface of the carefully honed cylinders. Piston pins are of nickel molybdenum steel and are 1 in. in diameter. Each pin is securely locked in its connecting rod by a clamp bolt, and operates in two hard cast bronze bushings in the piston. The camshaft is on the right-hand side, supported by four bearings 2 in. in diameter.

The engines are of L-head arrangement and the valves are the usual 45 deg. set type. The exhaust valves are operated by mushroom type tappets of nickel molybdenum steel.

Among other features of the Hercules "OO" Series engines is the provision included for a wide choice of accessories. Immediately in front of the water pump is provision for battery ignition by distributor, while any standard S. A. E. size magneto can be driven from the rear of the water pump shaft. In the center of the block, near the center line of the crankshaft, is an opening for attaching a pipe for thermo-syphon cooling.

The front support of the engine is furnished by a neatly designed bracket located on the gear cover. This bracket can be supplied for either three or four point suspension. Provision is also made for mounting a governor. The governor is of special Hercules design, which permits close speed regulation. It is easily adjusted by means of an accessible nut.

ROADS and STREETS

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Hoover's Great Construction Program for 1930

There has been a reduction in the construction of dwellings and industrial buildings (but not in public works) during the past six months. On the heels of this came the stock market slump. President Hoover and his great secretary of the treasury, Andrew Mellon, have announced that they do not regard the deflation of stock prices as an evidence of business weakness. On the contrary they attribute the decline in building to the high rates of interest brought about by abnormal stock market speculation and the flow of money into Wall Street.

Now that the stock speculation bubble has burst, Hoover has announced that he favors a great expansion of public works; and as the first great step in this program he proposes extensive river improvements and canalization that will ultimately result in reduced costs of transporting grain, coal, etc. He also favors enlarged programs of municipal, county and state construction of pavements, roads, water works, sewerage systems, etc. Without doubt the president's great prestige as an executive, engineer and political economist will cause his recommendation to be adopted. So there is assurance that 1930 will be the greatest year of public works construction in the history of America.

In addition to the impetus thus assured under the Hoover plan, it should be remembered that gasoline taxes are financing most of our road improvement programs. In California the monthly gasoline tax incomes are running 16 per cent ahead of those of a year ago. Most of the other states are also showing remarkable increases in gasoline sales, which means corresponding increases in funds available for road construction. Nor should the effect of increased production of automobiles and motor trucks be overlooked, not merely because of its effect on gasoline consumption but because of the increase in the number of voters who will insist upon having better pavements and wider and better roads. It is now certain that the total number of American motor cars and motor trucks produced in 1929 will be about 5,500,000. The old cars are not being scrapped at the rate that once was common, for cars are more durable and we are rapidly becoming a two-car-per-family nation.

As a result of President Hoover's business and economic conferences the greatest construction program in the history of the country has been developed for 1930. It is estimated that this will amount to over $10,000,000,000 and will include the following:

Roads and Streets	$2,200,000,000
Waterworks and Sewers	700,000,000
Steam Railway Construction	400,000,000
Federal Government Construction	750,000,000
Public Utilities	1,000,000,000
Building Construction	5,500,000,000
Total	$10,550,000,000

Over Two Billion Dollars for Road and Street Work in 1930

In a recent conference with President Hoover, he was informed that road and street construction in 1930 will reach $2,200,000,000, nearly half of this total being street construction. It was estimated that 1930 highway construction will exceed that of 1929 by 10 per cent.

For many years reliable statistics have been published as to annual expenditures on country roads, but only recently have efforts been made to gather comprehensive data on street work. It is very desirable that this street information be made fully as complete as that relating to roads. Familiar as we are with street construction activities, we admit being surprised when recently we read that during the past 18 years the city of Los Angeles had spent nearly $97,000,000 on street paving. This involved the paving of 1629 miles of streets.

In this connection it may be of interest to give the annual expenditures for street work, bridges, pedestrian tunnels, sewers and storm drains by fiscal years:

1918-19	$ 892,627
1919-20	896,769
1920-21	2,546,442
1921-22	3,291,714
1922-23	4,533,074
1923-24	8,083,922
1924-25	12,762,002
1925-26	19,006,029
1926-27	22,782,710
1927-28	27,537,920
1928-29	20,191,531
Total, 11 years	$122,524,740

Note that during the last 4 years $89,514,192 were spent for public works and that this was exclusive of buildings, water works, light and power plants, etc. Hence this city has recently been investing about $20 per capita annually in sewers and storm drains. During the past 18 years nearly 70 per cent went for street work and 30 per cent for sewers and drains. If this ratio existed during the last 4 years, nearly $12 per capita was invested in street improvement. Since about 70 per cent of our people live in incorporated towns and cities, there are about 84,000,000 urban residents, and if they average $12 per capita invested annually in street improvement, the total exceeds a billion dollars, which checks closely with the estimate of annual street construction costs for 1930 submitted to President Hoover.

Nation's Purchasing Power Not Affected by Stock Deflation

In not a few recent articles it has been said that, aside from some reduction in the buying power of the "fleeced lambs," no industrial injury has occurred as a result of the drastic deflation of stock prices. A little thought shows that not even this reduction in buying can affect the total buying power of the nation.

To begin with the earnings of the stocks remain unaltered by their reduced market prices, and it is only their earnings that furnish buying power. The dividends may go to other owners, but this is merely a transfer of buying power. The annual surpluses remain with the companies, so the buying power that those surpluses represent does not change hands.

As to "paper profits" resulting from a rise in stock prices, they are not buying power until the stocks are sold and the profits are actually made available; but when that occurs, and money is transferred, by as much as the seller gains in cash with which to buy goods the seller loses in cash. So, in the final analysis, the total buying power of a nation is unaltered by any change in the prices of stocks, so long as no international trading is involved. International trading in stocks is trivial in comparison with national trading, so this factor need not be considered.

The well known and oft-repeated truth is that the vast majority of Wall St. transactions that involve stocks are gambling transactions. It is pure sophistry to argue that many of the stock buyers and sellers are investors, for active stocks are turned over so frequently that the nature of the transaction is clearly apparent. Most of us have a gambling instinct, so when public gambling on horse races and the like is barred by law, many of us turn to a sort of gambling that is not thus prohibited, and we call it speculating. We are far from implying that laws should be drawn to prohibit or even to curtail buying on margin. On the contrary, let freedom be unconfined, except, perhaps, that phase of it that enables pools to rig the market. Sooner or later men will learn that intrinsic values are not in the habit either of skyrocketing upward or of falling like the stick; and it is better that they learn to beware of such stock markets as we have witnessed in recent years than that they be forbidden to speculate.

In this connection it may be well to point out why many stocks had such a spectacular rise for several years following the close of the world war. Take, for example, public utility stocks. The editor, as a consulting engineer on public utility appraisals and rate cases, was employed by many public utility companies for several years following the war; and testified before commissions and courts as to the rise in wages, materials, taxes that made higher rates of charge necessary. Also it was shown that the values of utility plants had risen as a result of the rise in wages and in prices of machinery and materials; and fair percentages of profit on these higher values were likewise necessary under our constitution. As a result of such hearings, of which the ones in which the editor was engaged, were merely typical of hundreds, the rates of street car fares rose from 5 cents to an average of about 7 cents, and other similar, although usually smaller, increases were secured by utility companies in other fields. Prior to these increases in rates, utility common stocks had declined in price because of inadequate earnings. As increased rates went into effect, such stocks began to rise, and in many instances they increased several fold in price. Seeing such increases in stock values, accompanied by earnings that fully justified the increases, the public eventually came to think that there was no end to the gifts of the Santa Claus they called our American prosperity. So they began discounting anticipated increases in earnings of utilities and railways that were destined not to occur.

In the industrial field a general rise in earnings was also largely due to rise in prices of products, resulting from the inflation in currency that the war had caused. Here the effect was more spectacular than in the utility and railway fields, because it was more sudden. It was sudden because commissions and courts did not delay the rise in rates of charge. Competition usually could not check the rise, for a competitor had to buy lands and plant at prices that had advanced, and was thus forced to charge higher prices for his products, except in those rare instances where a complete offset to such increased costs could be secured through increased efficiency of machinery. Let the value of an industrial plant and lands double as a result of currency inflation, let that plant be mortgaged for half its original value, and let common stock at par equal the value of the other half. Then what happens is this: A plant capitalized at $1,000,000 (half bonds and half common stock) becomes worth $2,000,000, on which the bond holders have a lien of $500,000, leaving an equity of $1,500,000 that belongs to the holders of $500,000 par value of common stock, which now becomes worth $1,500,000, or triple par. As such a stock works up to such a triple value, speculators become inflamed by the sight of rising values. Many who buy secure enormous profits during the rise, and become imbued with the idea that they are Napoleons of finance. Not understanding the underlying cause of the rise, they attribute it entirely to American prosperity. They read that never before has our nation increased per capita productivity so rapidly (which is true, but not the cause of rising prices). They see no reason why this productivity should not continue to mount, so they infer that stock prices will continue to mount, and err because their premise is wrong. Increasing per capita productivity does not increase prices; it decreases them. The industrial companies who are able to show rising net earnings per dollar of invested capital are only those that excel the others in efficiency. These, however, are in the minority, but they are a spectacular minority; and the continued rise of the value of those stocks adds fuel to the speculative furnace—until, at last, the boiler explodes.

Almost any stock purchased seven or eight years ago, following the post-war panic, was a bargain. Such purchasers came to believe that they had shown wonderful business acumen, when, if the truth were known, very few of them had correctly analyzed the problem, if we may judge from the writings of financial advisers during the last eight years. Babson, just before the recent crash, issued a warning to sell, but it is apt to be forgotten that he issued a similar one in 1921 at the very time that he should have been advising the purchase of stocks. And up to the very moment of the recent debacle, the great majority of the professional prophets in the realm of speculation were as optimistic as such prophets usually are.

During the editor's investigation of public utility rates, he analyzed the rates of return on the market values of all classes of American securities for many years back. Some of the conclusions thus derived were published in "Engineering and Contracting" and "The Analyst." The relation between the risk factor and the earnings of bonds and stocks was deduced; and the average "market price of money" was derived. Just before the recent bursting of the stock bubble of 1929, many stocks were selling at more than double the price warranted by the risk factor and the earnings. It was evident from such facts that "frenzied finance" was due for a fall. Many a banker had come to that conclusion. Our Federal Reserve System had issued repeated warnings. But it is the characteristic of nearly every one of us to be oblivious to such warnings, especially when we have ignored them and profited by ignoring them for a year or more. More than two years ago the warnings began to come from conservative bankers, but investors listened to market tipsters instead, and the headache of the day after is now theirs. We are deeply sorry for them. We have ourselves experienced, many years ago, their every feeling. Out of that bitter experience came the resolution never to buy stocks on tips, but to study methods of correctly appraising the intrinsic values of securities. You will be told that no values are intrinsic. This is quibbling over a definition. Certainly there are stock prices that exceed the present worth of prospective earnings, just as there are others that are below that worth. The successful investor, as distinguished from the speculator, first learns to appraise intrinsic values, and then backs his own judgment and not that of some tipster who sells or gives him advice but risks no money of his own.

The Distinction Between "experience" and EXPERIENCE

A sparrow roosting on a telegraph wire is not more oblivious to the passing messages than is every human being to most of Nature's code. The analogy is less far fetched than it may seem, for Nature does not speak in plain language but in codes that must be deciphered. Only in recent centuries have men realized that she is speaking at all, and comparatively few men realize that fact even now. Were it otherwise, there would be a hundred trying to decipher her messages where now there is one.

Although Nature has many codes, fortunately there is a fundamental kinship among them, so that when one is deciphered it makes easier the deciphering of others. This explains, a measure, the geometric ratio at which scientific knowledge is increasing. In spite of this rapid increase of understanding of natural laws during the past generation, the next generation will regard our recent progress as very slow, and their progress in turn will be similarly regarded by their children. It is well to emphasize this geometric ratio of scientific progress for two reasons: first, because it should reduce our conceit; and, second, because it should encourage a much greater percentage of our young men to become researchers.

It is a mistake to suppose that very many of our pure scientists are researchers. The vast majority of them are engaged in routine work, such as teaching. Even those who engage in research work usually can devote but a fraction of their time to it. Nothing is more clear than that if an hour a day spent in research results in valuable discoveries, eight hours so spent will result in many more discoveries.

In this connection it may be well to add that length of experience should never be measured by the total number of years of desultory study of a general subject, but by the number of hours spent in study of some particular subject. We say study, for nearly all of value that experience yields is the result of study. Merely plowing, sowing and harvesting of wheat would never have enabled Burbank to develop a superior sort of wheat. Many a farmer can qualify as having had more "experience" with wheat than Burbank ever had. But Burbank devoted several hours daily for several years to the intensive study of wheat, and learned more about wheat than all our farmers ever knew. As part of that study he experimented with wheat secured from every corner of the earth. As he was at the same time making similar studies of other plants, it is not unlikely that the sum total of the hours devoted exclusively to his study of wheat was not more than 3,000, or the equivalent of 300 days of 10 hours each. So we can well imagine the smile of superiority with which the average wheat farmer might have compared his own 20 years of "experience" with Burbank's one year of EXPERIENCE, not realizing that the one is about of the same order of "experience" as a mule gets in pulling a plow, whereas the other is of an order that has made man "the lord of creation."

Here and there, for perhaps five million years, an occasional man has studied—intensively studied—some phenomenon or some device by which natural forces could be made to serve men. Thus the roller and later the wheel and axle were invented. Still later the pneumatic tire and the ball bearing, to mention only the evolution of the wheel. Thus the stars were seen apparently to revolve about the earth; and amid the myriad that seemed fixed in a heavenly sphere, a very few were seen to wander—the planets. A study of these wanderings at last suggested that the earth also was a wanderer, circling around the sun. More study showed to Kepler that these wanders move in elliptical paths. Still more study showed to Newton the nature of the forces that caused these paths to be elliptical, and thence came the first mathematical law that applied to every sort of matter in every part of the universe. A few men then definitely decided that although Nature's codes are often difficult to decipher, it had been proved that they are decipherable by persistent study. Experience for them had ceased to be merely passive observation or desultory study, and had become directed observation and persisting study.

When an engineer says, "I have had 20 years' experience," he may really mean much or little, for he may mean "experience" or EXPERFIENCE. He may have accepted facts as they came accidently to to his attention, or he may have been a purposeful searcher for information—a real student of the forces of nature that he seeks to employ in the economic service of his fellow men.

H. P. Gillette

Periodical

ROADS AND STREETS

Design, Construction, Maintenance and Traffic Control

H. P. Gillette Editor

December, 1929 Vol. LXIX. No. 12

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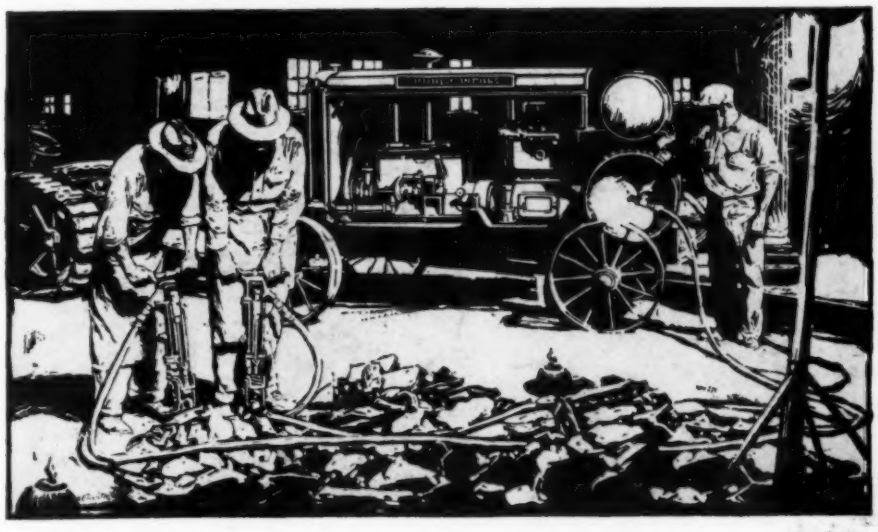

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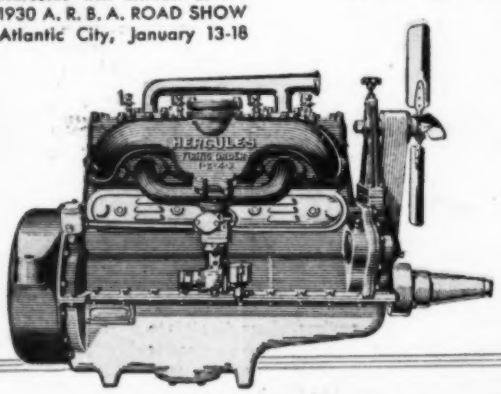

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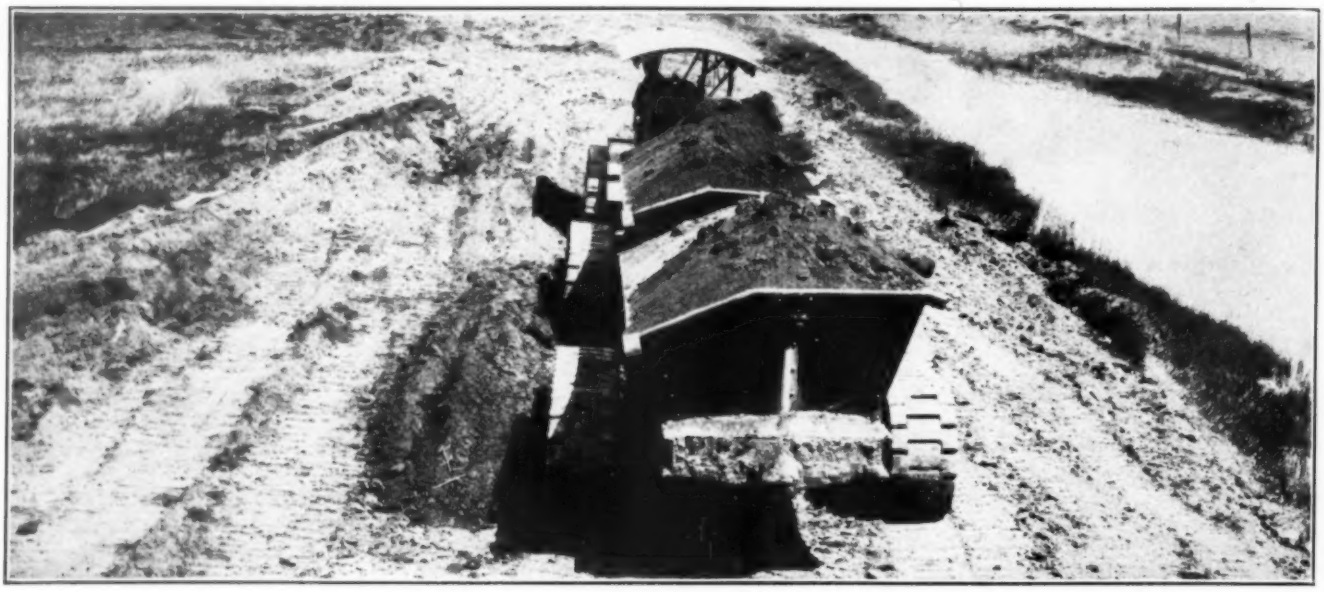

This is typically the sentiment expressed by so many other builders of Hyattized equipment, and borne out by the unfaltering performance of Hyattized units in service.

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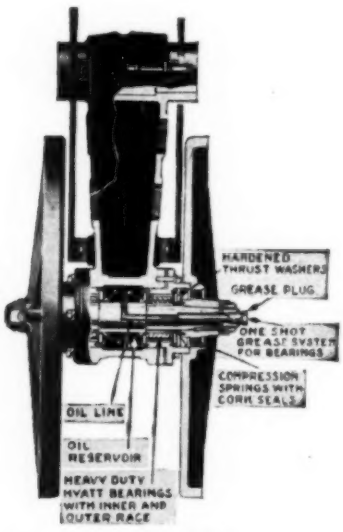
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ROADS AND STREETS

H. P. GILLETTE, Editor

Vol. LXIX DECEMBER, 1929 No. 12

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***See the Road and Street Catalog & Data Book**

In addition to the advertising messages to be found in this issue of Roads and Streets on the pages as indicated above, condensed catalogs of those marked * as well as other specifications and construction data will be found in the Road and Street Catalog and Data Book, the 384 page annual reference guide for the highway industries, published by the Gillette Publishing Co.

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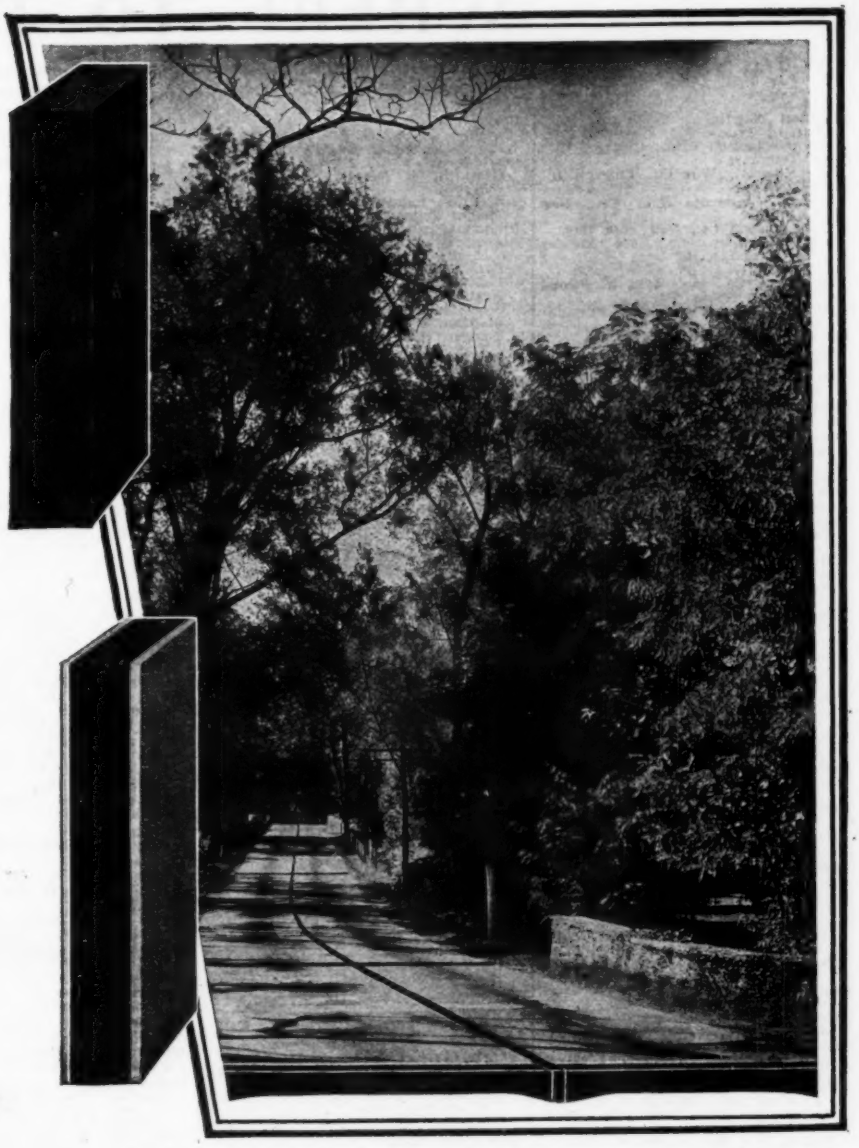

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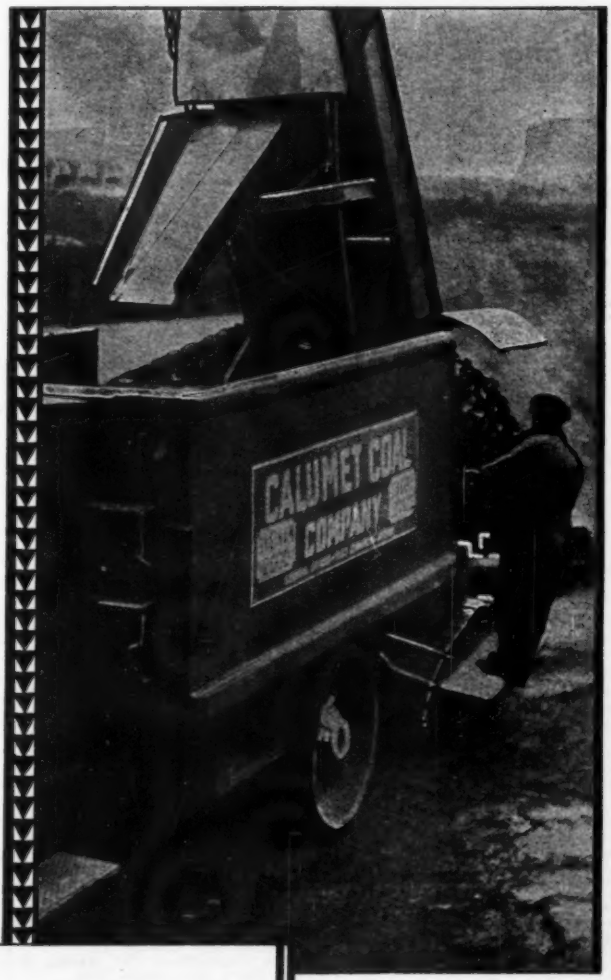

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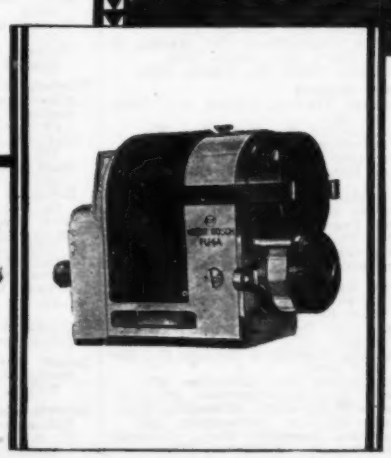

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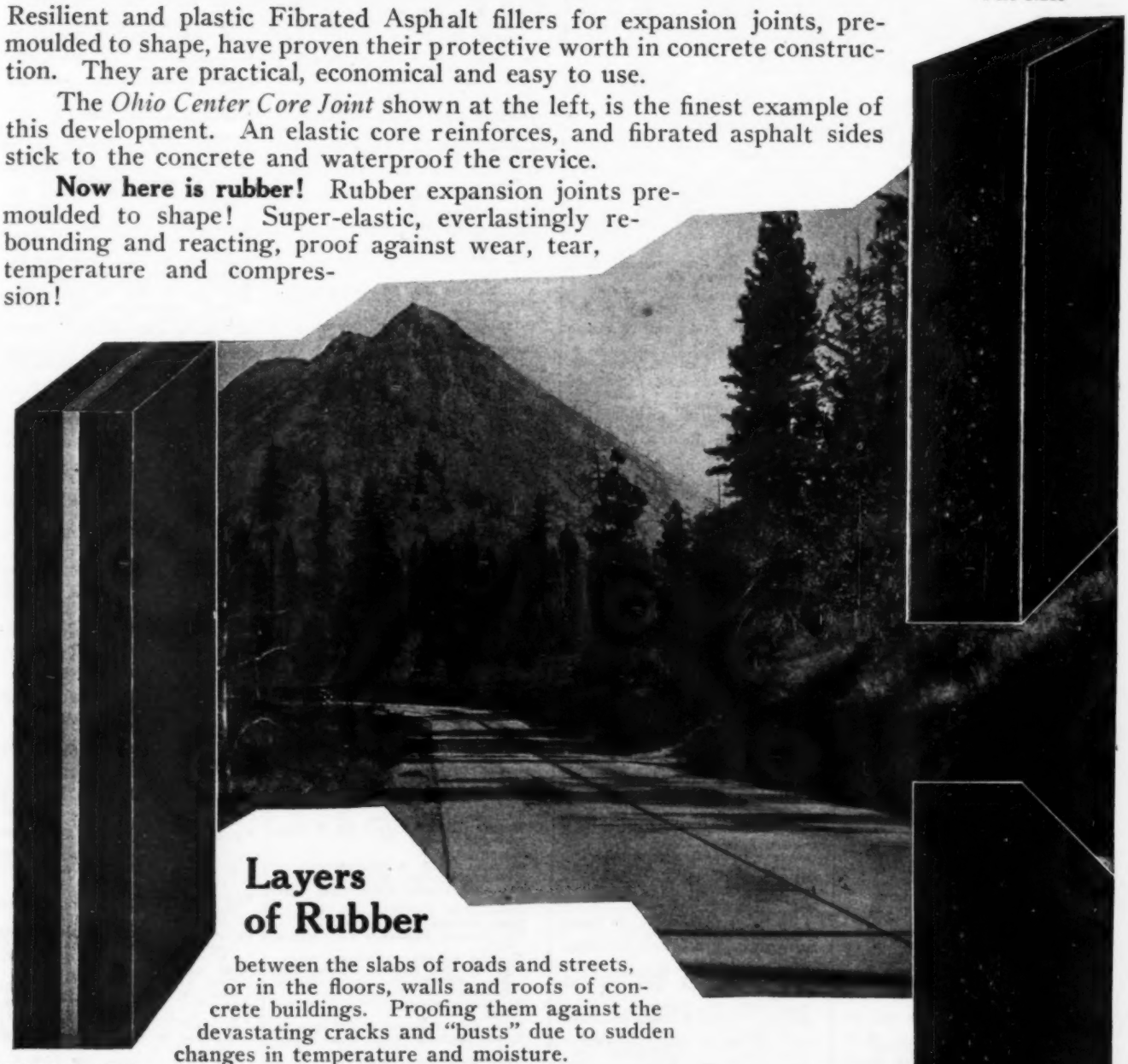

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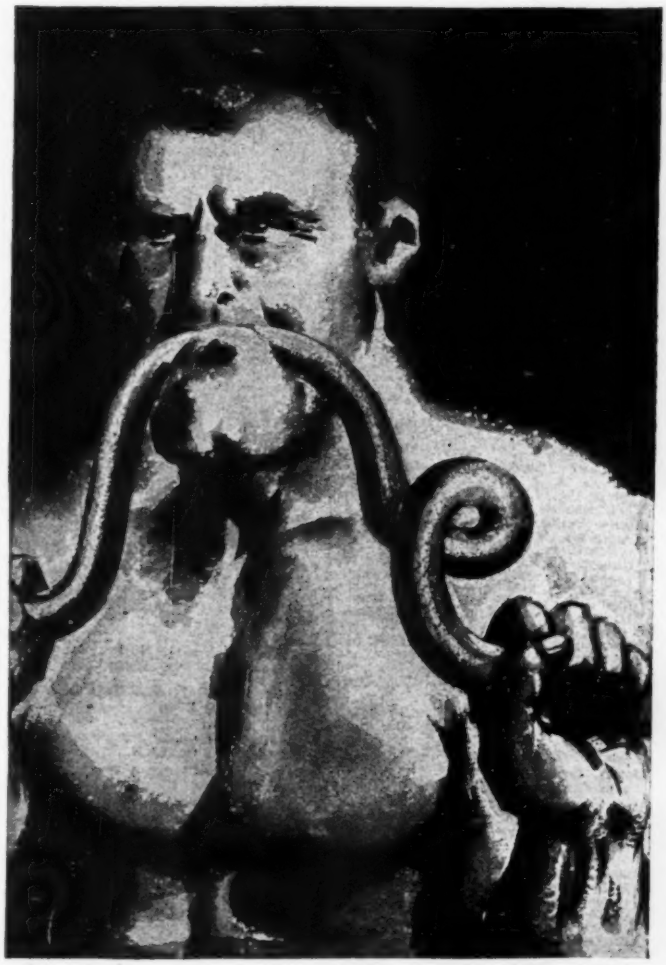

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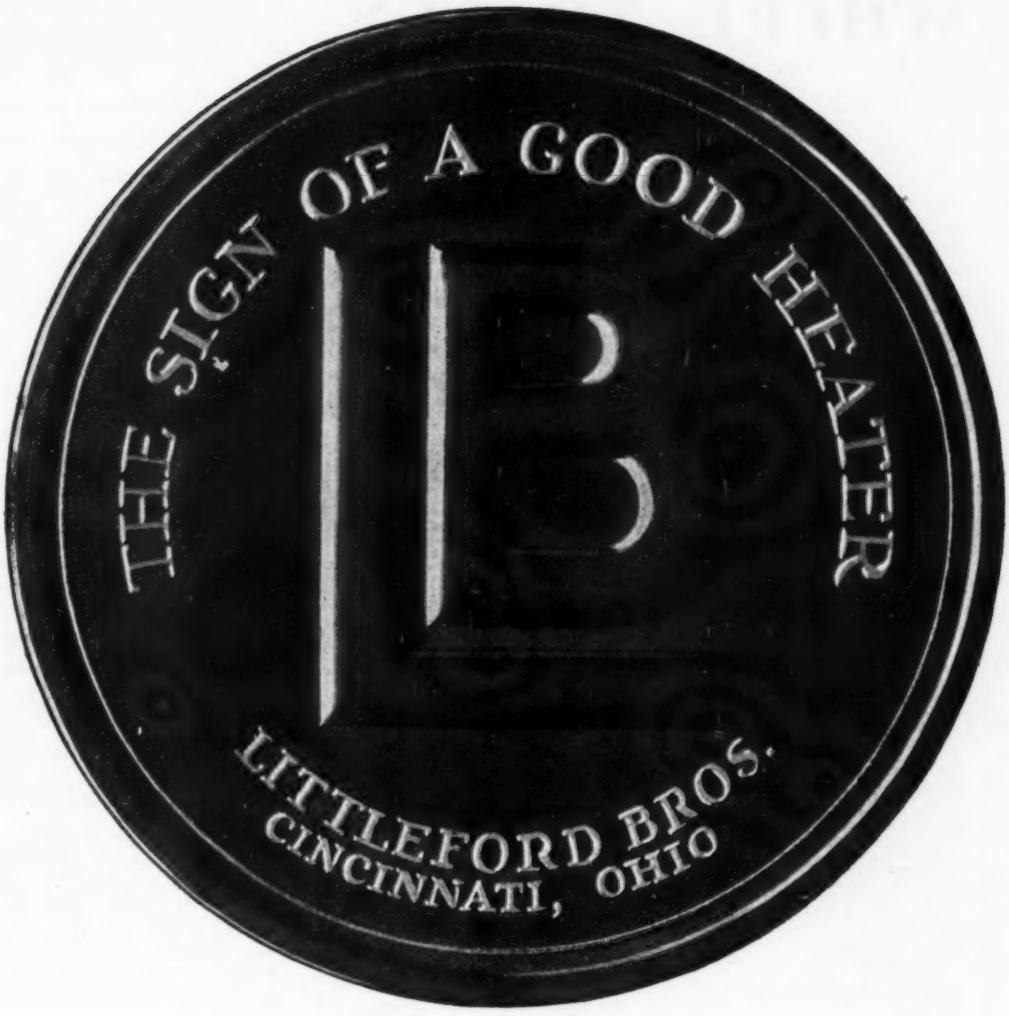

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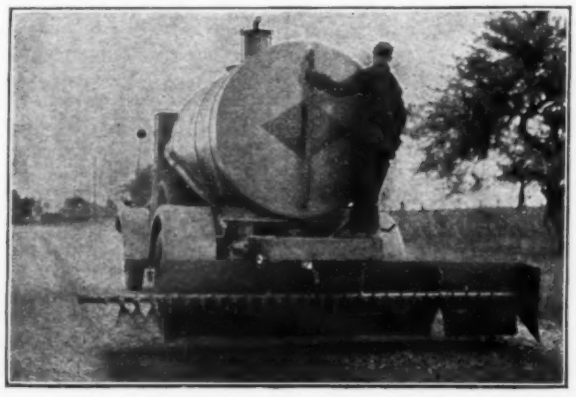

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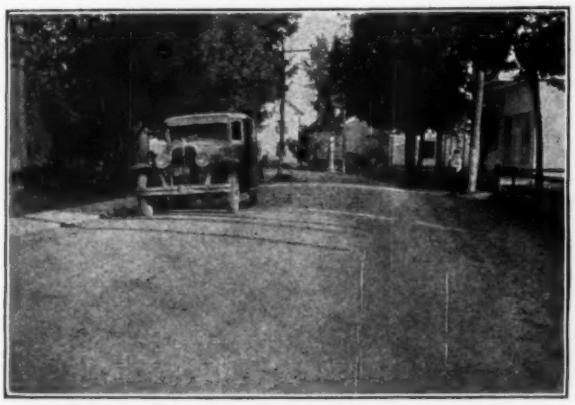

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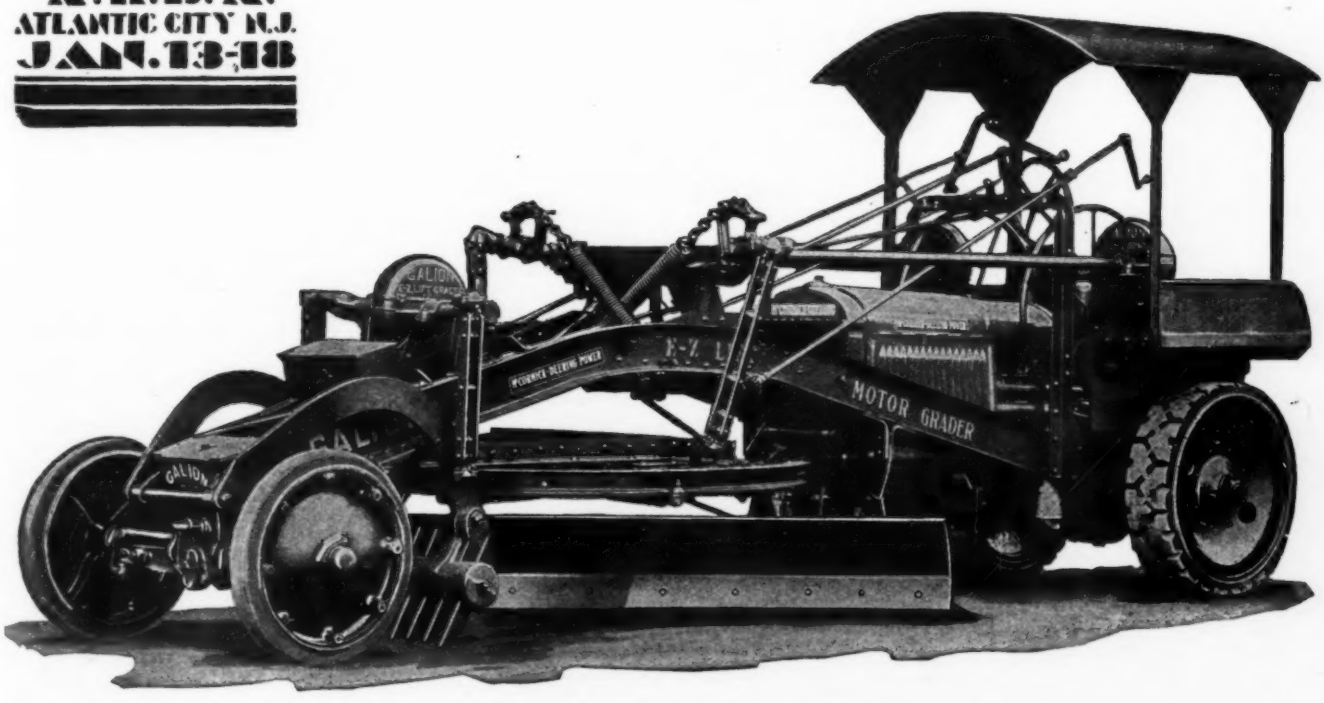

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Concrete Steel Co., New York, N. Y.
Ryerson & Son., Inc., Jos. T., Chicago.
Wood Steel Co., Alan, Conshohocken, Pa.

Treads, Stair and Ladder
Wood Steel Co., Alan, Conshohocken, Pa.

Treads, Traffic Steel (Bridges)
American Pressed Steel Co., Philadelphia, Pa.
Central Iron & Steel Co., Harrisburg, Pa.
Ryerson & Son, Jos. T., Chicago, Ill.
Wood Steel Co., Alan, Conshohocken, Pa.

Trenchers
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Buckeye Traction Ditcher Co., Findlay, Ohio.
Bucyrus-Erie, So. Milwaukee, Wis.
Harnischfeger Corp., Milwaukee, Wis.

Trench Braces
(See Braces, Trench.)

Trench Machines
Buckeye Traction Ditcher Co., Findlay, Ohio.

Trolleys, I-Beams
Harnischfeger Corp., Milwaukee, Wis.

Trucks, Dump
Graham Brothers, Detroit, Mich.
Hug Co., Highland, Ill.
International Harvester Co. of America, Chicago, Ill.

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Chevrolet Motor Company, Detroit, Mich.
Coleman Motor Corp., Chicago, Ill.
Four Wheel Drive Auto Co., Clintonville, Wisc.
General Motors (Chevrolet), Detroit.
Graham Bros., Detroit, Mich.
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Trucks, Machinery
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Lee Trailer & Body Co., Plymouth, Ill.

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Hug Co., Highland, Ill.
Western Structural Co., Moline, Ill.

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Lidgerwood Mfg. Co., Elizabeth, N. J.
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Marion Steam Shovel Co., Marion, O.

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Atlas Engineering Co., Clintonville, Wis.
Gallon Iron Works Mfg. Co., Gallon, O.
Good Roads Machinery Co., Inc., Kennett Square, Pa.
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Industrial Brownhoist Co., Cleveland, Ohio.
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Unloaders, Coal and Stone
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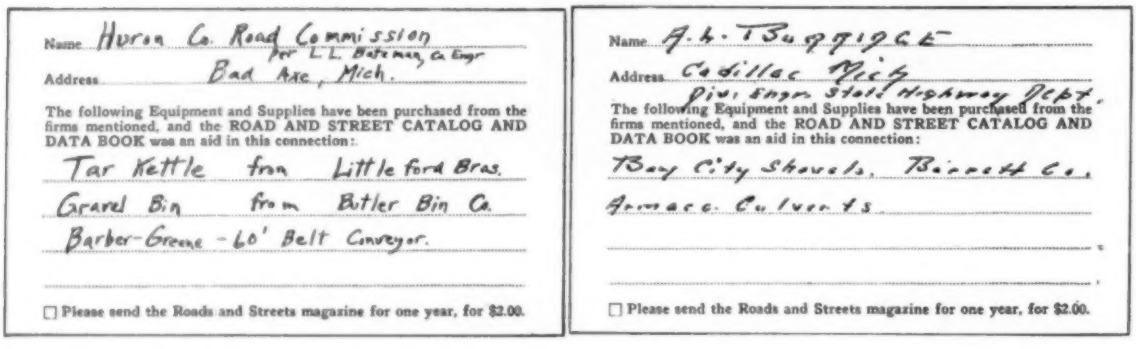

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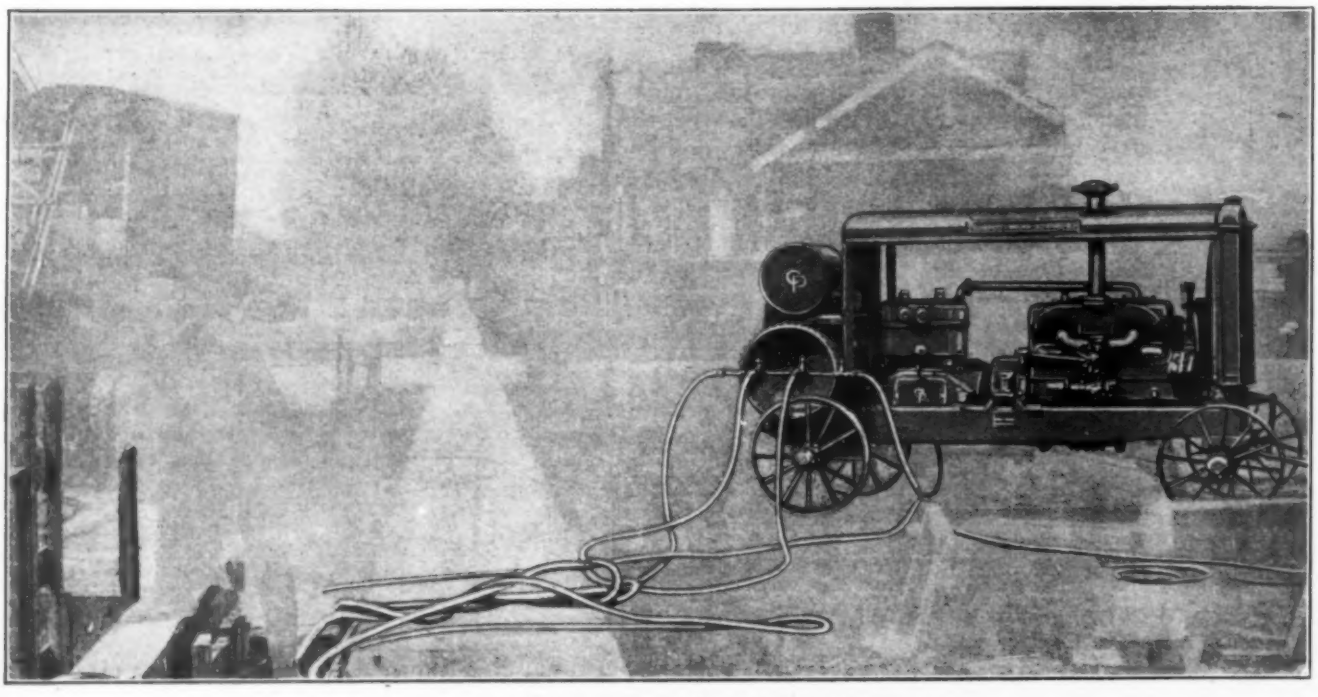

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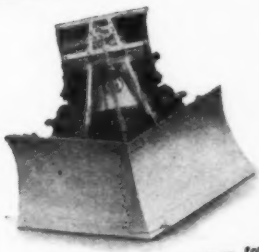

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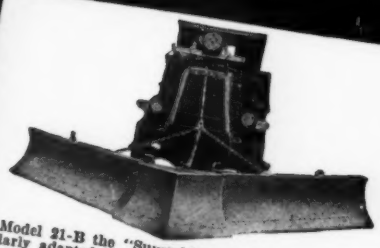

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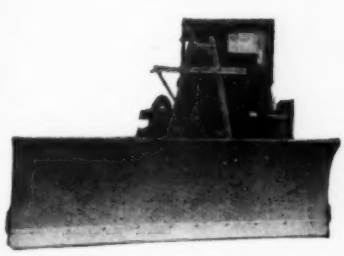

Model 25—Reversible blade type with extra high moldboard. Similar to Models 10-D and 11-B. For use on trucks of from 2½ tons capacity and heavier.

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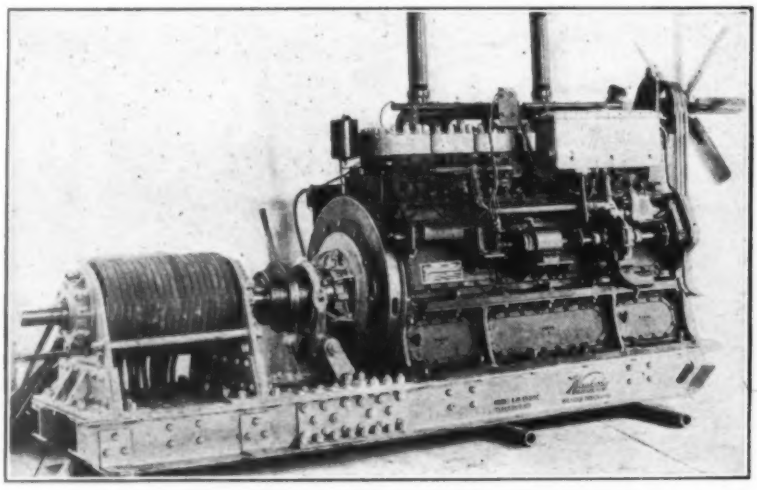
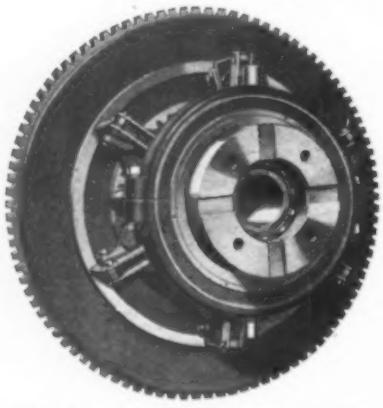


Compact clutch installation on 275 H. P. Waukesha engine.



Clutch used in engine above. An efficient heavy duty type now available in several sizes.

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At any rate, we hope you will accept this invitation and come in to see us, whether we can add to your profits this year or not.

TWIN DISC CLUTCHES

TWIN DISC CLUTCH COMPANY

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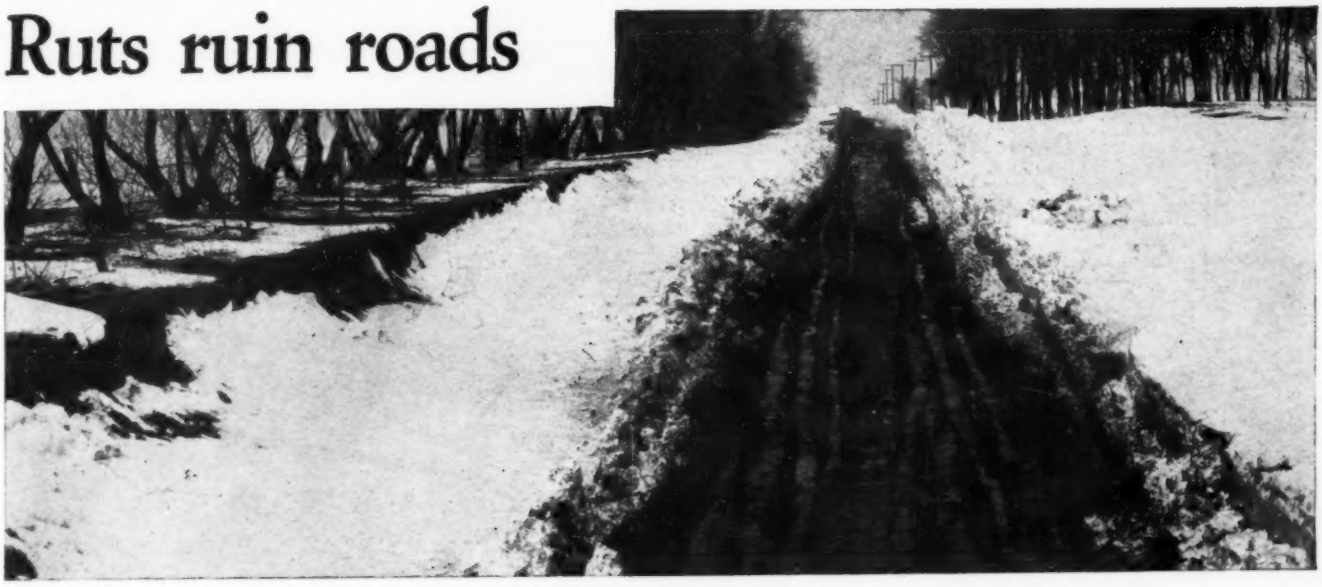

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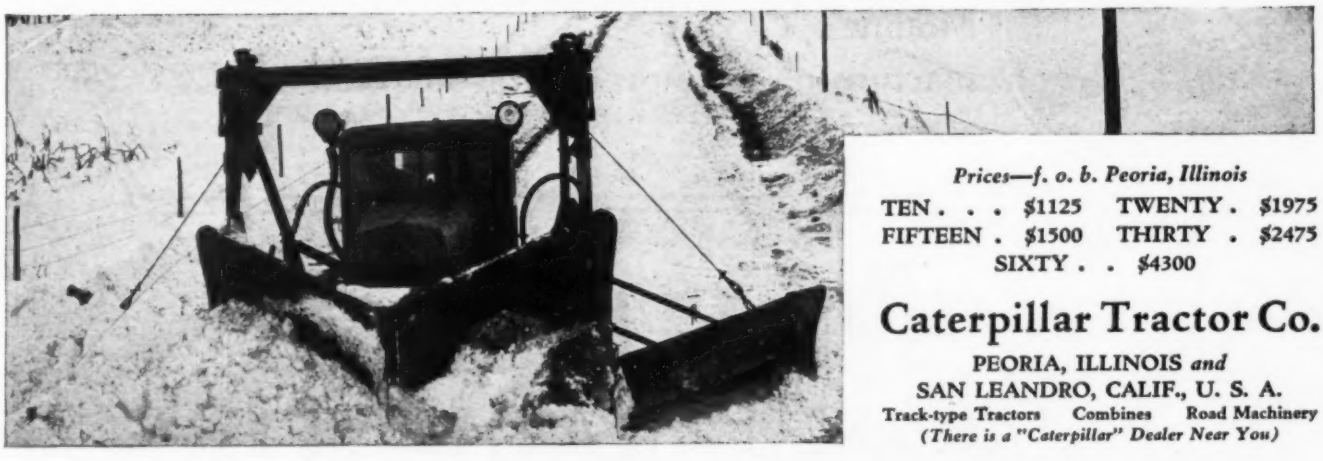

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It cleans the street from curb to curb, and

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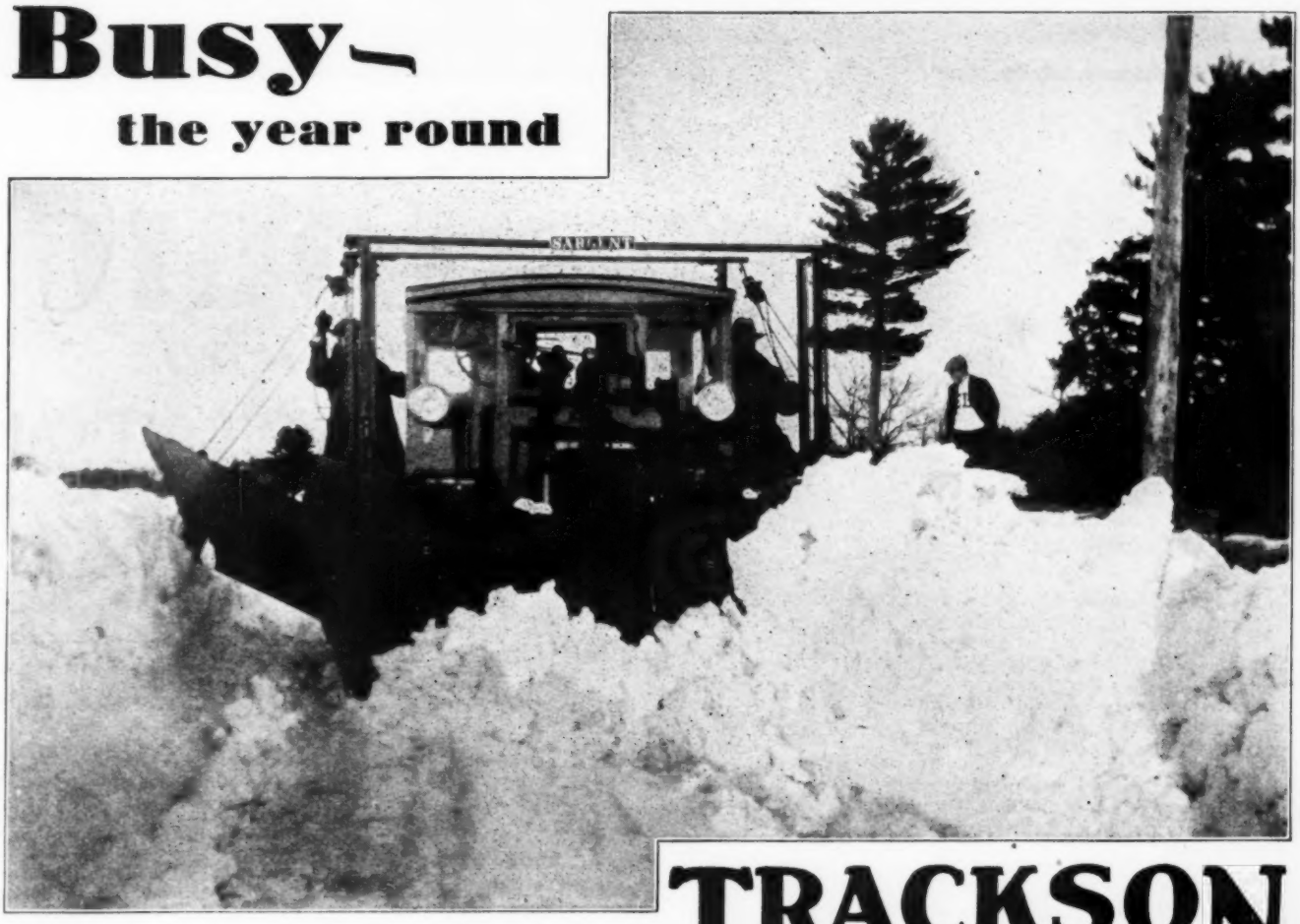

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ROLLING back the heavy drifts with a big snowplow, or clearing the light falls with a grader blade . . . cleaning out ditches, or snaking wagons and trucks from a mud hole . . . purring along with a one-man grader, or back-filling tons of dirt in one mighty shove—it's all in the year's work for Trackson McCormick-Deerings. Snowplows, bulldozers, one-man graders, etc., are easily attached to and detached from these all-purpose crawler-tractors because of wide clearance between the tracks and motor. Low cost, dependability and year-round usefulness further make them just about the wisest investment any community can make. Write for folder 177.

MODEL LH

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FULL-CRAWLERS & TRACTOR EQUIPMENT

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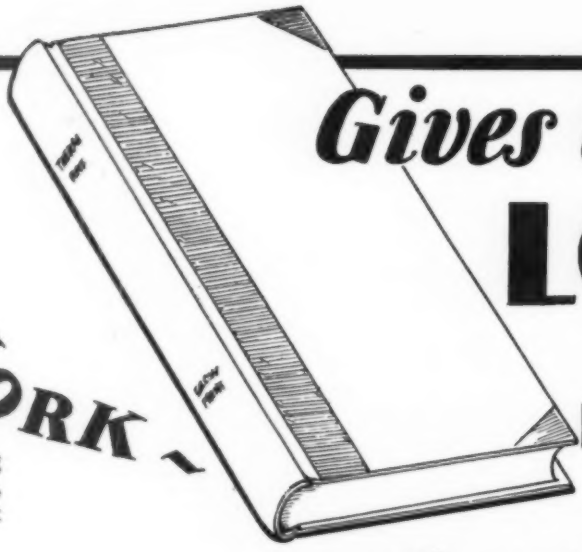

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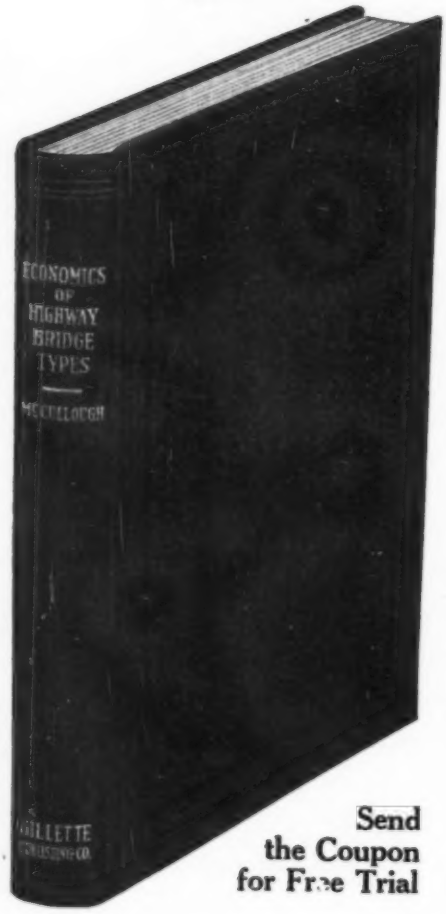

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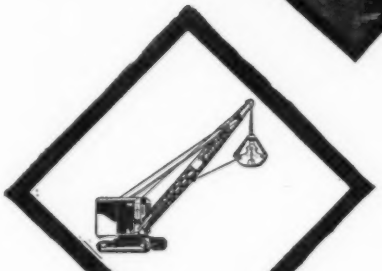

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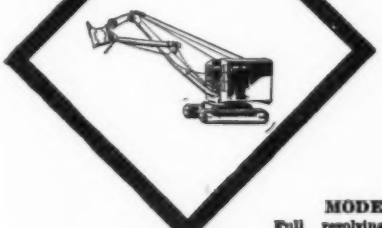

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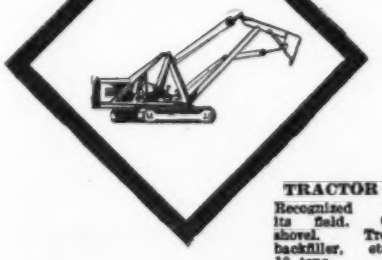

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Recognized leader in its field. Operates shovel, Trench hoe, backfiller, etc. Weighs 10 tons.

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In a recent report made by the Bureau of Public Roads they say in part, "The Shovel is the primary producer—an inferior shovel or operator is a certain guarantee that production costs will be high. The shovel should be sturdy, powerful, dependable, fast and easily operated."

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Crowd, hoist and *swing* count in Power Shovel operation—you get them and more in BAY CITY SHOVELS—Compare with any others of same capacity before making your choice.

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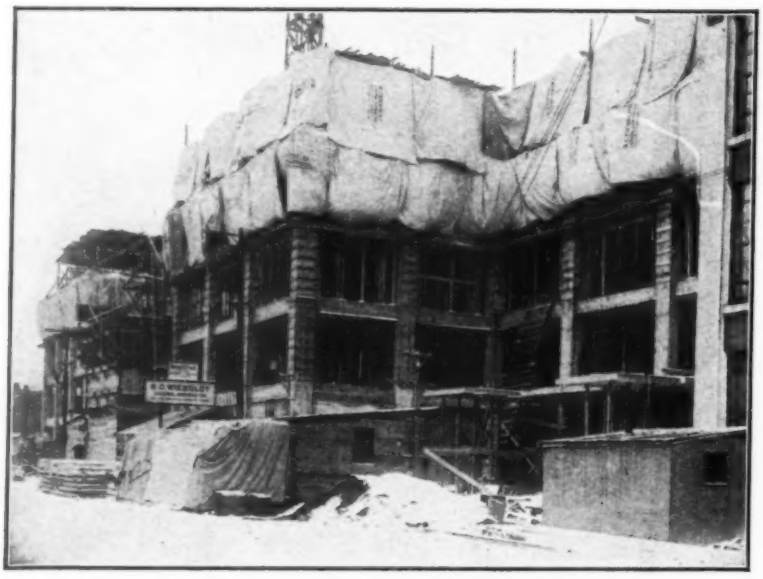
BAY-CITY

The BAY CITY family of fast workers



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4. Concrete when placed in forms should have a temperature of 70° to 140° F., and not allowed to drop below 60° for the first 24 hours.
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Write for complete instructions on securing dependable high-early-strength concrete with PRESTOLITH VELO CEMENT, regardless of cold weather, using no admixtures or accelerators.

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BUILDING
FOR A GREATER
TOMORROW

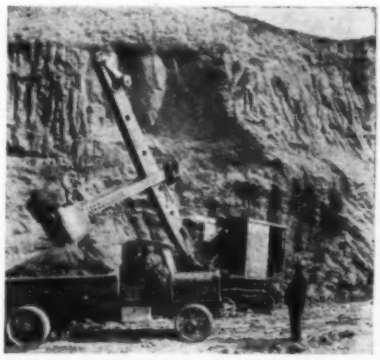
Up goes your dipper—steadily, surely, relentlessly forcing its way through solid earth that breaks and crumbles, rolls and tumbles — while spectators gather, fascinated and awed.

In a thousand and one places, in many lands, the constructors of today are digging — building for a greater tomorrow! And depending on Bucyrus-Erie shovels for unfailing performance.

World leadership of this half-century old organization is based, first of all, on a true knowledge of the equipment needs for each and every excavating job. Knowing these needs, Bucyrus-Erie has developed each machine to do the special work it is built for — maintaining in each the proper distribution of weight, the correct application of power, and the true relationship of every part that must exist for dependable, low-cost operation and long service.

Small shovels, large shovels — any type for any job — Bucyrus-Erie builds them all. And follows each sale with world-wide service!

SEE US AT THE ROAD SHOW — SPACE 214



Power shovels, clamshells, cranes, draglines, dragshovels—½ to 16 yard capacity—electric, steam, gasoline, Diesel, gas + air, Diesel + air.
Dipper, hydraulic and placer mining dredges. Tower-excavators and Railway cranes.

A-7
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TRAFFIC MUST *MOVE!*

Airplane view, intersection Michigan Superhighway (upper level) with Southfield Superhighway. In the lower right foreground are the twin bridges carrying the double roadways of Southfield Superhighway over the altered channel of the River Rouge. Next toward the center of the view, is the structure carrying the double tracked Michigan Central Railroad over Southfield. Farther to the left is the superhighway intersection itself. Built under direction Board of County Road Commissioners, Wayne County, Michigan. H. A. Shuptrine, Bridge Engineer; Leroy C. Smith, Engineer-Manager.

IN Wayne County, Michigan, just outside of Detroit, two superhighways intersect at a right angle, in flat country. By separating the levels of the two thoroughfares, the heavy traffic on both flows across the intersection without delay or congestion.

Ingenious secondary roadways connecting the upper and lower levels permit vehicles to turn from one road to the other without the hazardous "left turn." Concrete pavement on both highways facilitates normal traffic speed with complete safety. Wide as the double roadways and concrete bridges are, they may be widened even more whenever the volume of traffic demands.

"It is the forerunner of thousands of such separations that will ultimately be constructed over the nation, for it was built to fill a demand and not to create one."

—Edward N. Hines, Chairman Board of County Road Commissioners, Wayne County, Michigan.

PORTLAND CEMENT Association

33 West Grand Avenue . . . Chicago

CONCRETE FOR PERMANENCE

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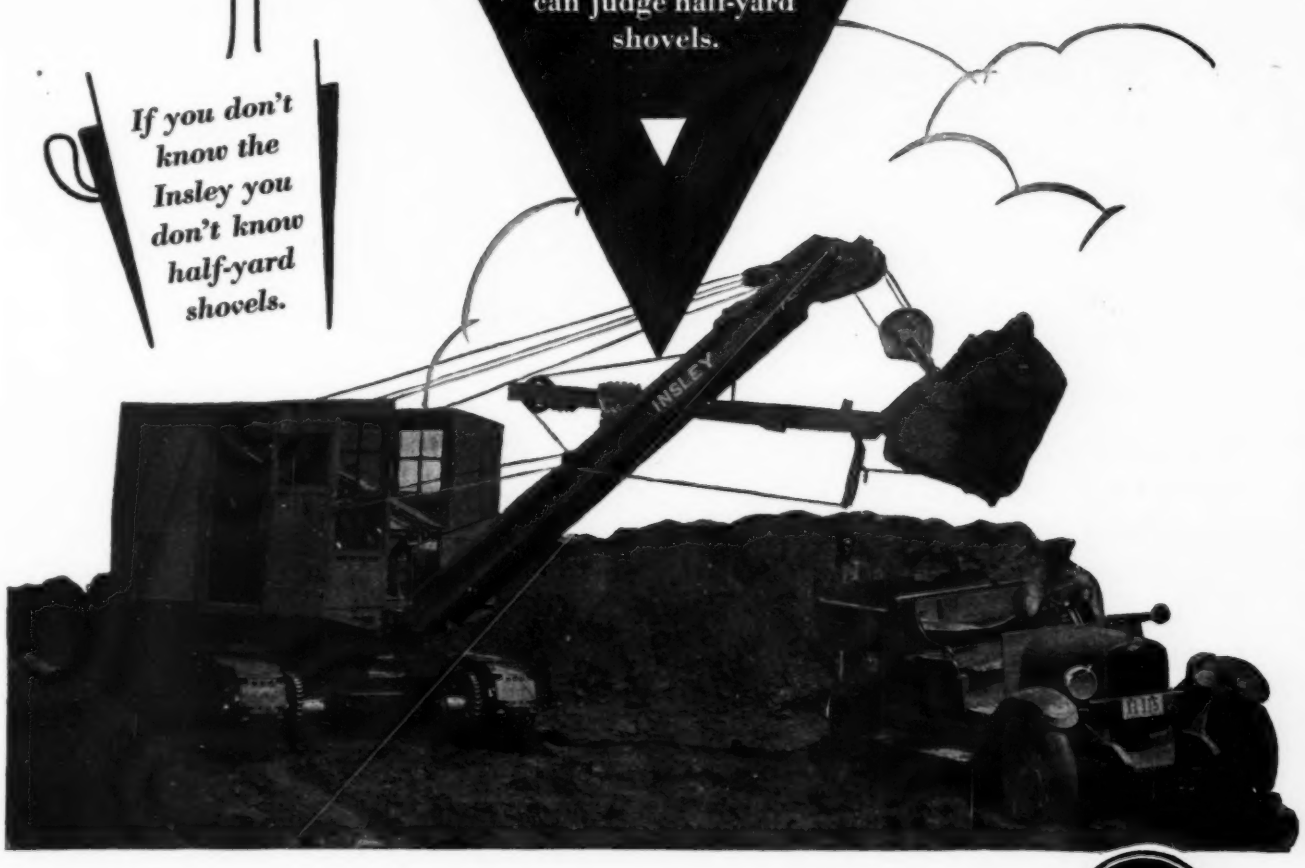
WHERE your standard of value originates—where you return to compare whatever else you have seen—that's "the starting point." . . . . . The Half-Yard Insley is "the starting point" in the half-yard shovel field. Because of its operating speed, its ball and roller bearing construction, its operating ease and flexibility—because of its universal adaptability and its startling and consistent performance the half-yard Insley gives you a set of values by which you can judge half-yard shovels.

If you don't know the Insley you don't know half-yard shovels.



INSLEY

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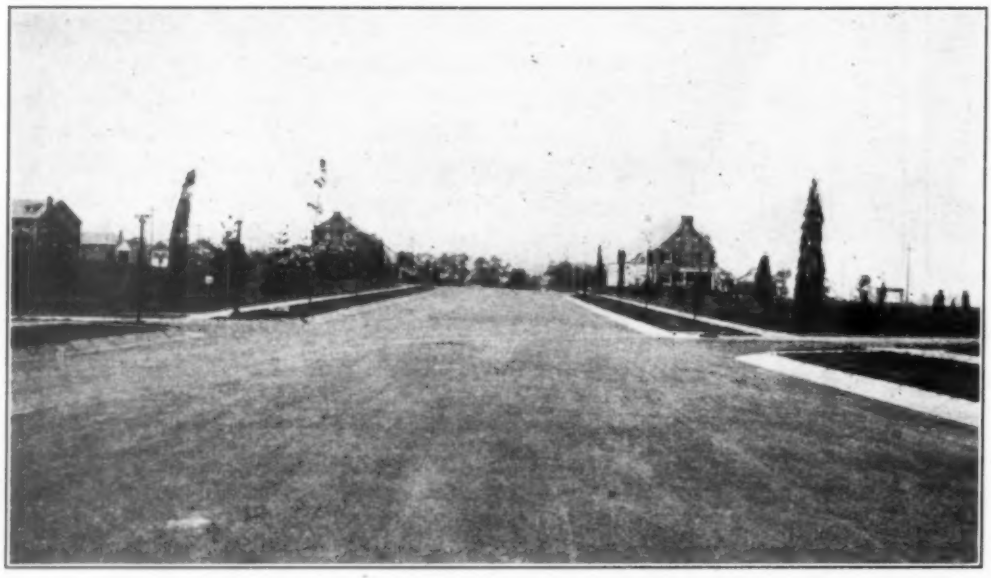
INSLEY MANUFACTURING COMPANY, Engineers and Manufacturers INDIANAPOLIS, INDIANA *Division of National Equipment Corporation*

Westphalt
TRADE MARK

The Improved Asphalt Pavement



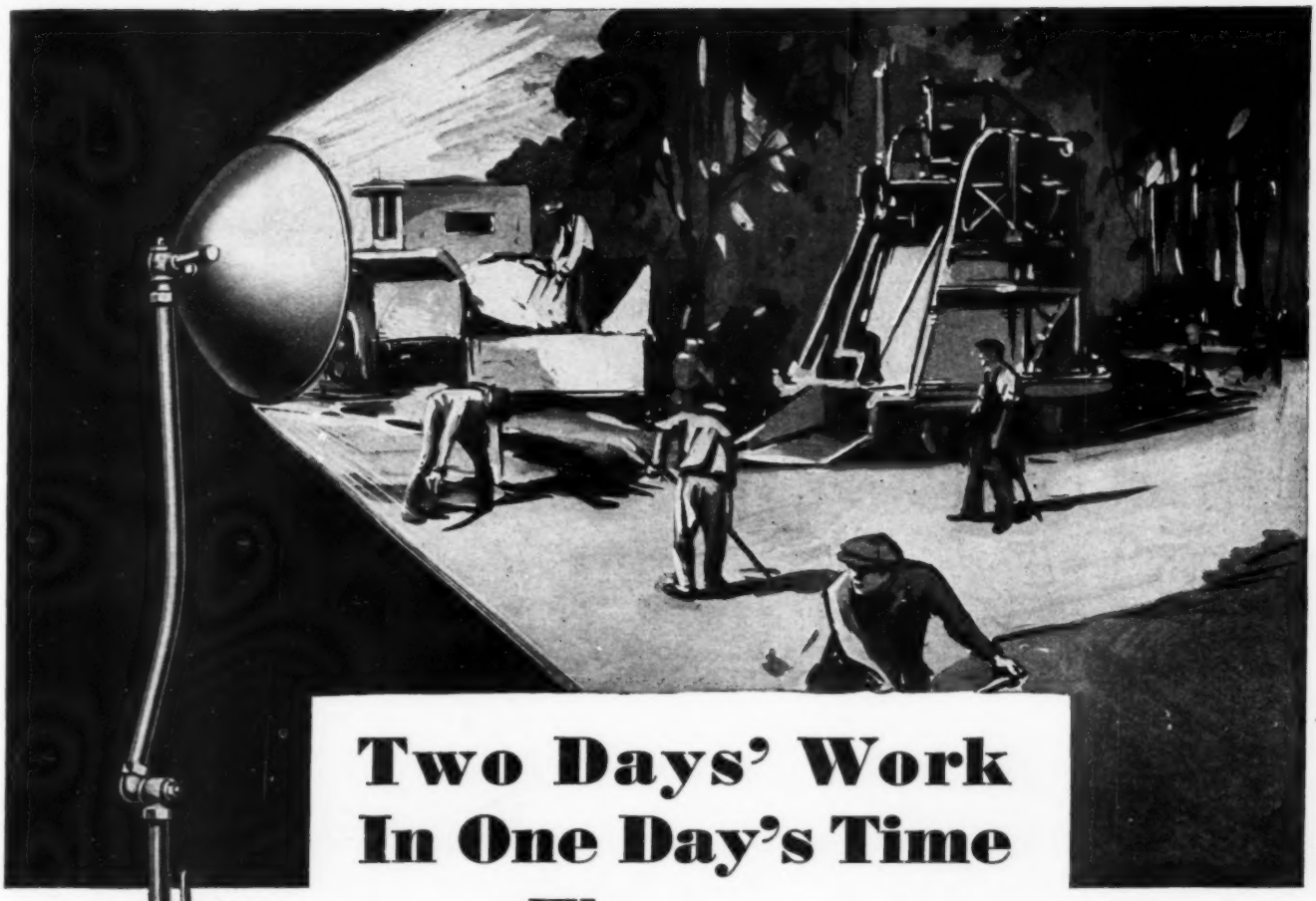
WESTPHALT on McGrann Boulevard in Grand View Heights, Lancaster, Pa. Over two miles of wide streets have been paved with it. Its smoothness, resiliency and freedom from skid pleases all of the residents.

The WESTPHALT was heated in a concrete paver, spread, raked and rolled. Thus a true "hot-lay" asphalt pavement of the highest type was layed by a contractor who had no hot-mix plant.

AMERICAN ROAD BUILDERS' ASSOCIATION
1930 CONVENTION AND ROAD SHOW
JAN. 13–18
ATLANTIC CITY, N.J.

WEST PROCESS PAVEMENT COMPANY, INC.
LOUISVILLE, KENTUCKY
Branch Plant Offices—Richmond, Va., and Harrisburg, Pa.

Please mention ROADS AND STREETS—it helps.



Two Days' Work In One Day's Time

WHEN days grow shorter—when dark hours crowd out productive operation—speed up your job with a night shift.

Carbic Flood Lights are powerful, portable units that supply clear white perfectly diffused light. They are rugged pieces of equipment built to serve you night after night.

Carbic Light requires no costly installation. Any inexperienced workman can charge it in a few minutes—and it is ready for hours of continuous service.

Carbic Light costs only a few cents an hour.

Extend Your Working Day With
CARBIC LIGHT

OXWELD ACETYLENE COMPANY

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Carbic is distributed by the Union Carbide Sales Company through its national chain of warehouses and is sold by jobbers everywhere.

CARBIC

PROCESSED CARBIDE FOR CARBIC LIGHTS & GENERATORS

Technical Publicity Department, Oxweld Acetylene Company
205 East 42nd Street, New York, N. Y.

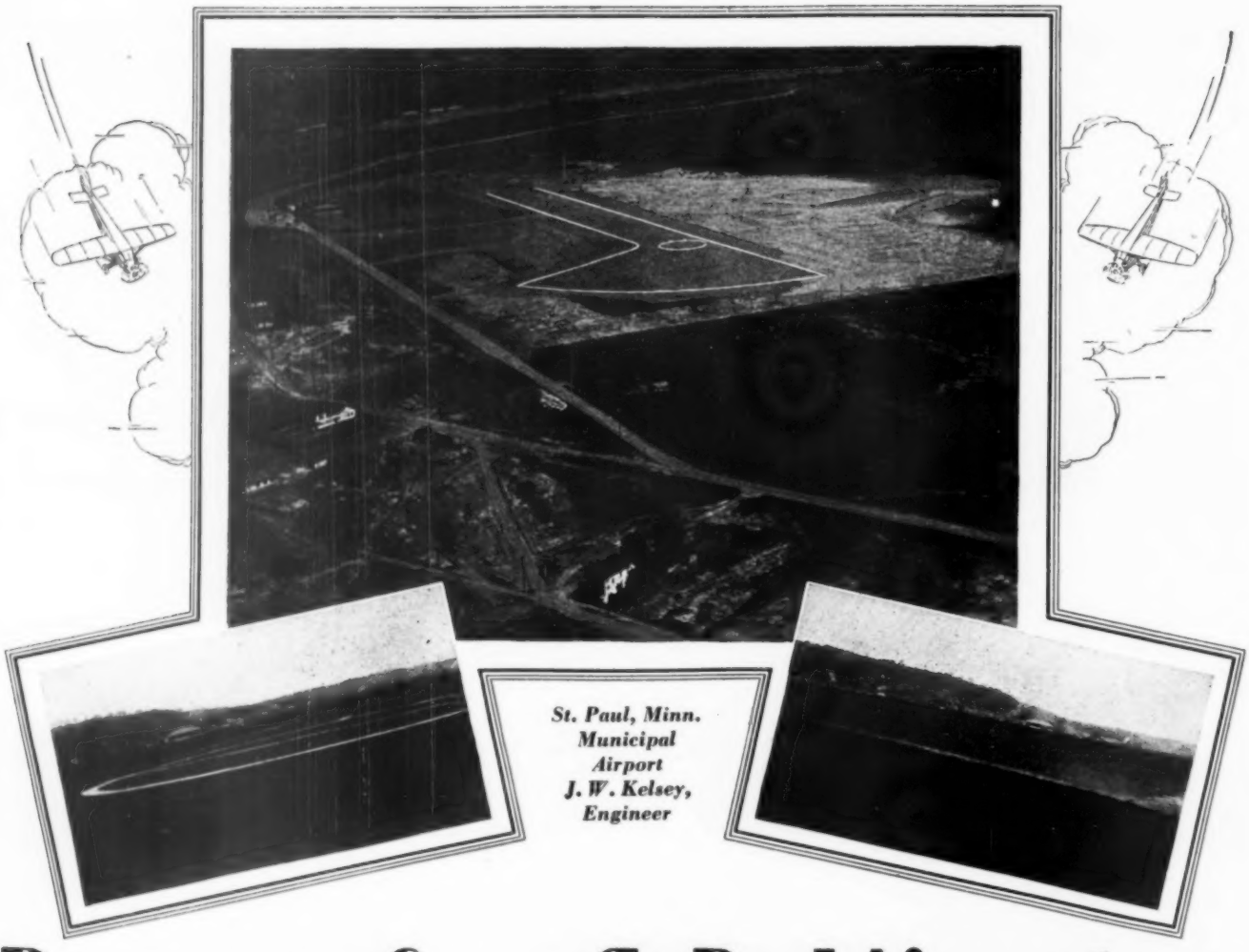
Without obligation, I would like to have additional information on Carbic Lights.

Name .....

Street Address .....

City ..... *State* .....

B&S-12-29



St. Paul, Minn. Municipal Airport J. W. Kelsey, Engineer

Runways of new St. Paul Airport are built with Stanolind Paving Asphalt

The new Municipal Airport at St. Paul, Minnesota, will be, when completed, one of the finest of its kind in the country, having a hydroplane bay as well as a landing field.

In the building of the runways, Stanolind Paving Asphalt was used. The construction consisted of 2 inches of Hot Mix Asphaltic Concrete on Penetration Macadam or Black Base.

This is the highest type of runway paving

STANDARD OIL COMPANY

910 South Michigan Ave. (*Indiana*) CHICAGO, ILLINOIS

224

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AND NOW A MARION DIESEL-ELECTRIC

TIDEWATER Timber Co. of Portland, Oregon, finds in this new shovel all the economy of the Diesel with the fine operating characteristics of the steamer. Ask for full details.

THE MARION STEAM SHOVEL CO.
MARION, OHIO, U. S. A.

MARION

29032

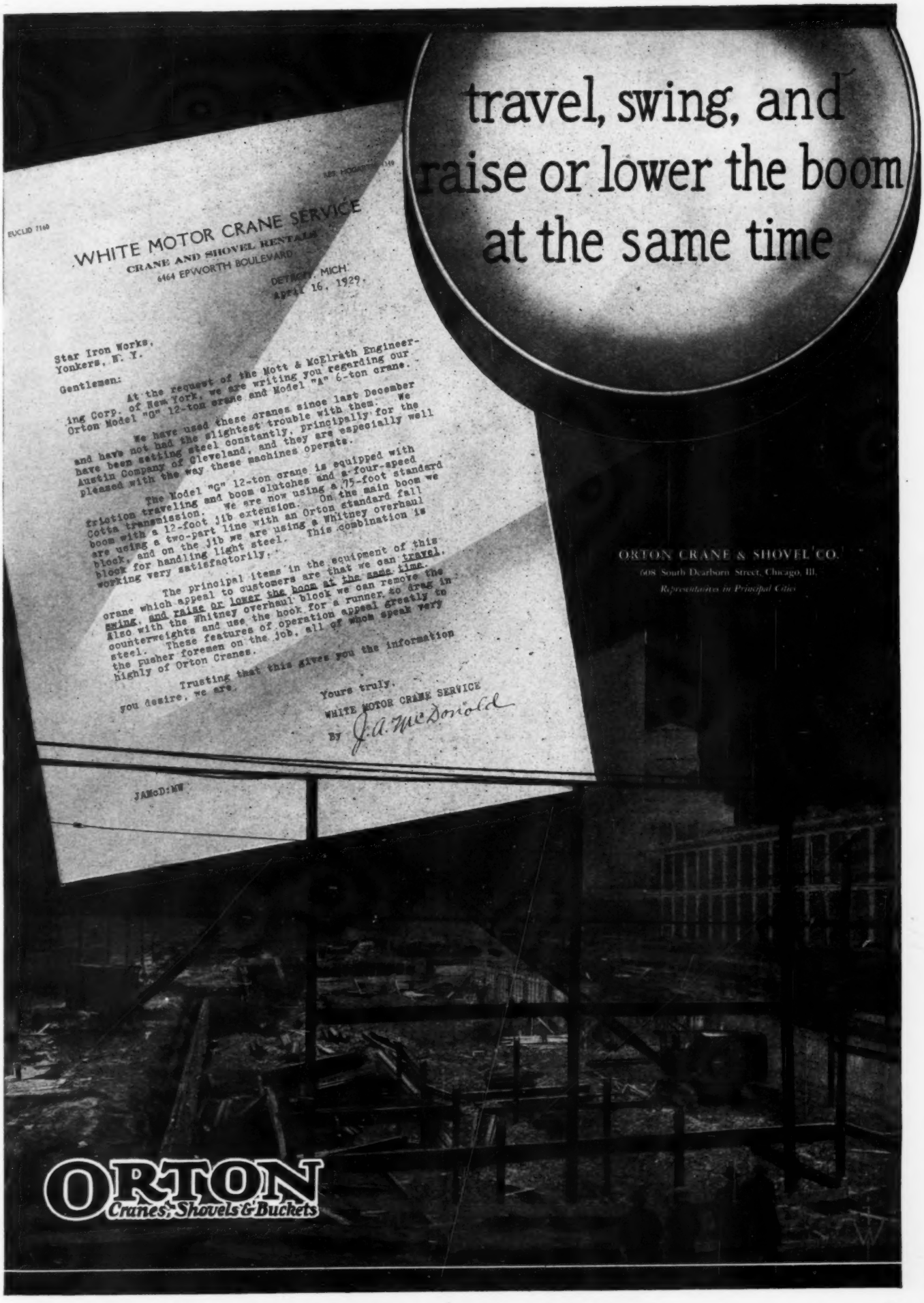
All in this one pavement!

Vitrified brick pavement, properly constructed, more than meets every modern requirement. It withstands grinding wear and seasonal changes, year after year. It needs little or no maintenance. And it also assures attractive appearance plus smooth riding. That's service, that's economy, that's quality—all in this one pavement!

For further information address National Paving Brick Manufacturers Association, National Press Building, Washington, D. C. (Exhibitors at American Roadbuilders Convention and Show, Atlantic City, Jan. 13-18, 1930.)

VITRIFIED
BRICK PAVEMENTS
FACE THE FUTURE · PAVE WITH BRICK

Yes—we would like you to mention ROADS AND STREETS.

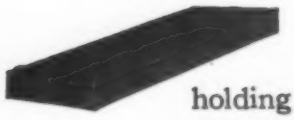

travel, swing, and raise or lower the boom at the same time
EUCLID 7160
WHITE MOTOR CRANE SERVICE
CRANE AND SHOVEL RENTALS
6464 EPWORTH BOULEVARD
DETROIT, MICH.
April 16, 1929.
Star Iron Works,
Yonkers, N. Y.
Gentlemen:
At the request of the Mott & McGrath Engineering Corp. of New York, we are writing you regarding our Orton Model "G" 12-ton crane and Model "A" 6-ton crane.
We have used these cranes since last December and have not had the slightest trouble with them. We have been setting steel constantly, principally for the Austin Company of Cleveland, and they are especially well pleased with the way these machines operate.
The Model "G" 12-ton crane is equipped with friction traveling and boom clutches and a four-speed Cotta transmission. We are now using a 75-foot standard boom with a 12-foot jib extension. On the main boom we are using a two-part line with an Orton standard fall block, and on the jib we are using a Whitney overhaul block for handling light steel. This combination is working very satisfactorily.
The principal items in the equipment of this crane which appeal to customers are that we can travel, swing, and raise or lower the boom at the same time. Also with the Whitney overhaul block we can remove the counterweights and use the hook for a runner, to drag in steel. These features of operation appeal greatly to the pusher foremen on the job, all of whom speak very highly of Orton Cranes.
Trusting that this gives you the information you desire, we are,
Yours truly,
WHITE MOTOR CRANE SERVICE
By J. A. McDonald
JAMcD:MW
ORTON CRANE & SHOVEL CO.
608 South Dearborn Street, Chicago, Ill.
Representatives in Principal Cities
ORTON
Cranes, Shovels & Buckets

That's an *Elastite* product there!

THE heavily traveled, surface-smooth Avenue "U" at Brooklyn, N. Y. Protected against expansion and contraction stresses by Carey Elastite Expansion Joint, installed longitudinally as well as transversely.

And that's why the road — stays — so — smooth

THE concrete is wrinkle-proofed—perfectly and permanently protected by Carey Elastite Expansion Joint. Notice that the joints are installed lengthwise as well as transversely—a doubly effective safeguard against expansion and contraction strains.



CAREY ELASTITE EXPANSION JOINT is made in sandwich form. An inner filling of special asphalt composition, holding outer-sheets of asphalt-saturated felt, both prepared at Carey's own plant and preformed under pressure. Easily installed, in any weather. Its protection is lasting and its cost is but a fraction of the finished construction job. Write for particulars on Expansion Joint installation.

THE PHILIP CAREY COMPANY, *Lockland,* CINCINNATI, OHIO

Carey Elastite
EXPANSION JOINT

Yes—we would like you to mention ROADS AND STREETS.

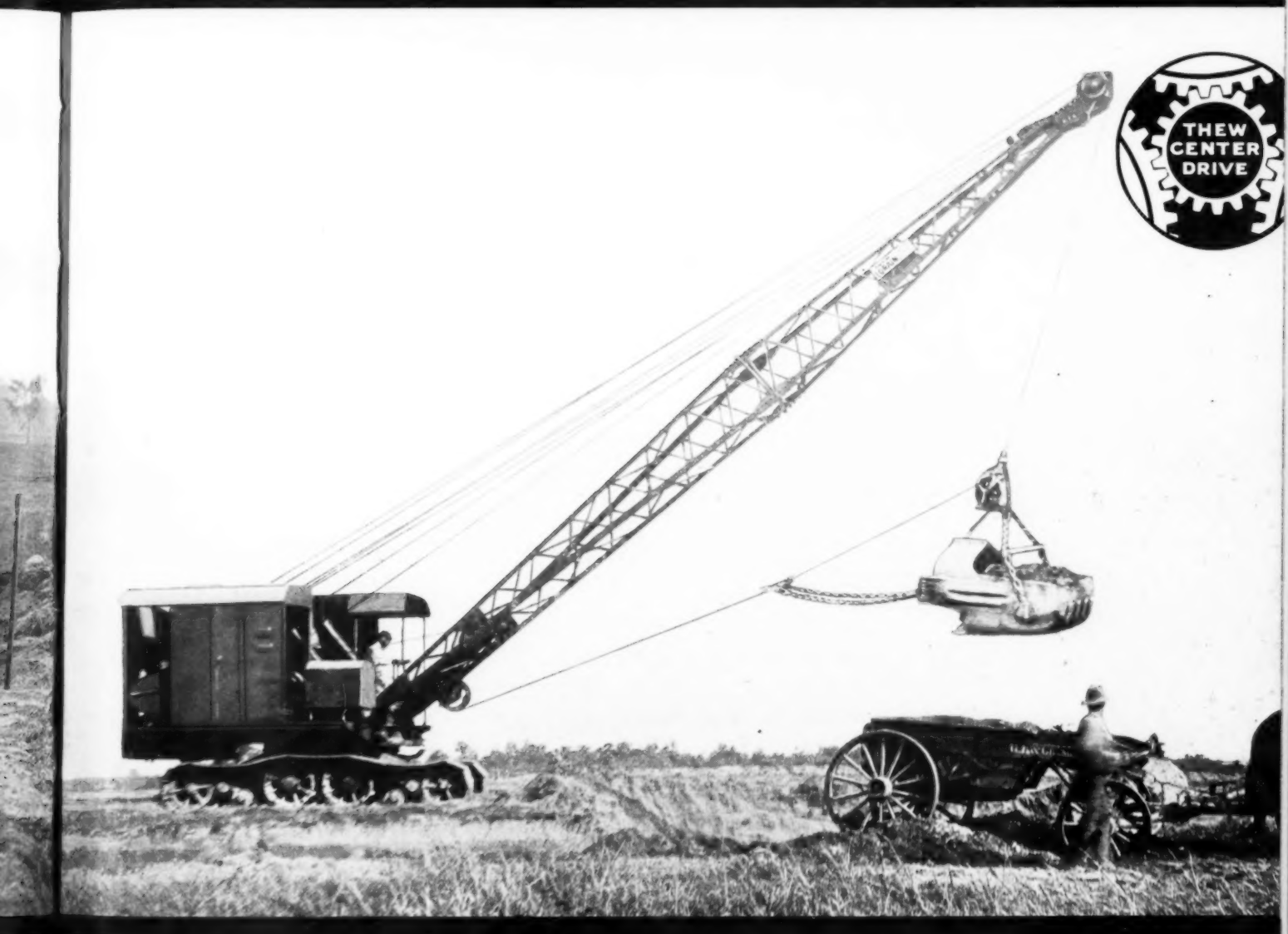
News from THEW

THEW HEAVY DUTY
Better Than

A BIGGER GAS, Diesel or Electric motor . . . 97 H. P. in the gas engine with a follow through of smashing power for the peak loads. An improved "56" Tread Crawler — 2 Speed Center Drive . . . longer, heavier, and more powerful than ever before. Simplified clutches with roller bearing boosters . . . automatic dipper trip . . . . And improvements and refinements that make this the best machine Thew has ever built.

1¼ YD. LORAIN 75B

Ever Before



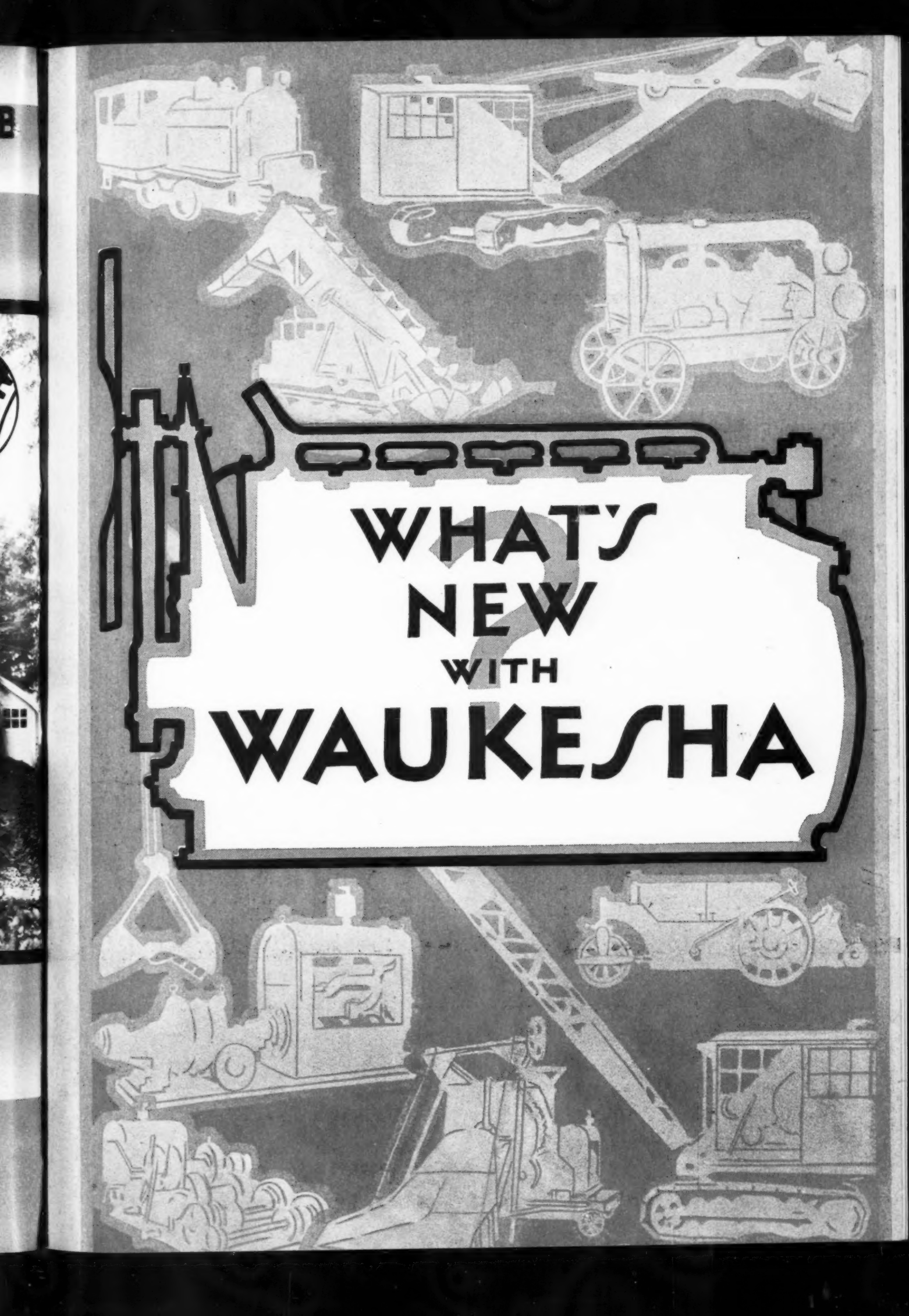
THE NEW heavy duty power plant and Center Drive superstructure convertible to crane, clamshell, or dragline . . . hoists, swings and travels simultaneously. Newly developed "64" and "68" Tread Crawlers with equalizer rocker arms . . . greater over-all length . . . increases supporting area . . . reduces ground pressure 15% to 25% . . . "Noses out" of soft material—rolls up and over broken ground . . . . . .

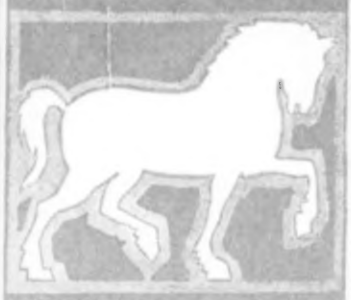
Heavy Duty Lorain 75B BACKDIGGER

AN improved backdigger boom with simplified, direct application of power to the dipper . . . backed by a more powerful motor. New type "64" and "68" Tread Crawler—2 Speed Center Drive . . . self adjusting to the unevenness of the ground . . . equalizer rocker arms eliminate digging in . . .

See these machines at the Road Show or write to us for complete descriptions.

THE THEW SHOVEL COMPANY • LORAIN, OHIO


WHAT'S
NEW
WITH
WAUKESHA



1930 MODELS ARE COMING

STOP-LOOK-LISTEN

LIENTS... engineer friends ...and prospective users of Waukesha Power... all look each year to Waukesha for what's new in power!

The answer is—new manifolding ... new carburetion...new oiling...new economy...and a new "dark horse."

See for yourself Waukesha's tangible contributions to progress ... the improvements in design, construction and operation...as they are embodied in the new Waukesha engine models to be disclosed at the Road Show.

988

WAUKESHA ENGINES

WAUKESHA MOTOR COMPANY

WAUKESHA, WISCONSIN

OSGOOD PIONEERED

IN SIX CYLINDER Power!

Osgood built the first revolving shovel 1890—was the first to use steel castings for all parts subjected to strain—first to use the six cylinder engine—and will always be the leader in this field.

THE OSGOOD CO.
MARION-------OHIO

Forget Your Concrete Curing Troubles

You can bid all your concrete curing troubles farewell forever by discarding the old, time-worn methods of curing. You can speed up construction, open your roads in half the time, cut costs, and know that your pavements will stand up under heavy traffic if you use Dowflake Calcium Chloride as your curing agent.

Dowflake is a clean, white, odorless flake that absorbs moisture from the air. It holds this moisture for long periods of time, accelerates the set of concrete and gives it a higher than normal early strength. Properly used, it reduces the tendency to surface voids and pitting and minimizes the freezing danger.

Dowflake gives remarkable results either as a surface curing agent or in the mix. And it is easy to handle and apply. Write for our free book, "How to Cure Concrete," and other information.

THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

Be sure to visit the Dowflake Display at the Road Show, Atlantic City, January 11th to 17th inclusive.

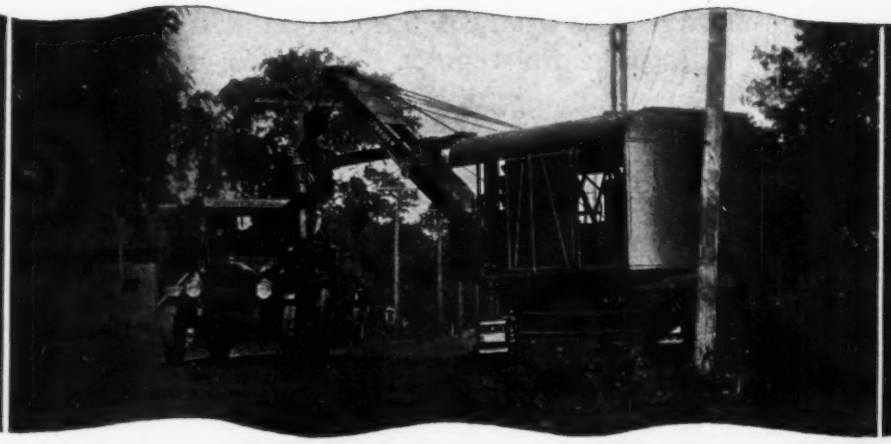
PATENTED FEBRUARY 17 - 1925
DOWFLAKE
CALCIUM CHLORIDE
DOW

Yes—we would like you to mention ROADS AND STREETS.

DEPEND ON THE SPEEDER CROWD

You can slope the banks and excavate below the treads for curb and gutter with your standard Speeder shovel. Speeder owners the world over easily do the unusual jobs with the simple direct-action, two-piece Speeder Cable Crowd.

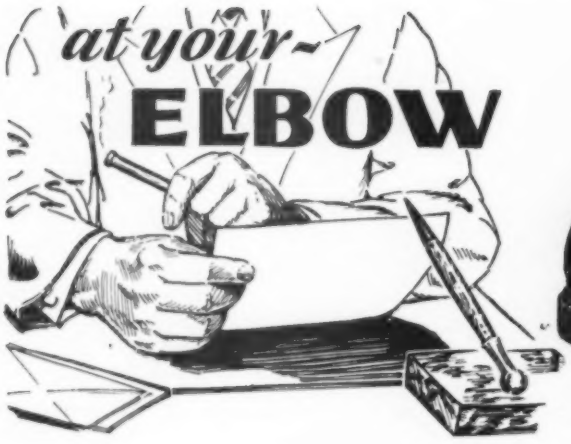
1930 CONVENTION & ROAD SHOW A.R.B.A. ATLANTIC CITY N.J. JAN. 13-18



Speeder Machinery Corporation

Pioneer manufacturers of full revolving, fully convertible, one-half yard gasoline shovels

1201 South Sixth Street, West Cedar Rapids, Iowa, U.S.A.



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What IS KOEHRING HEAVY DUTY?

DON'T let it be told you that it means just weight or the use of merely heavier metals of inferior strength!

Trust the name of Koehring that no construction makes greater use of special metals and steels combining great strength with lightness!

Koehring Heavy Duty construction means extra weight where extra material means longer service — it means always the best of metal and special *steels* — always the liberality of bearings, dimensions and structural strength that contribute greater reliability of service, lower maintenance, longer service life! How else could the Koehring have earned its outstanding reputation for long life?

Koehring Heavy Duty is always the greatest value you can buy in a mixer.

SIZES

Pavers — 27-E six cylinder Waukesha engine, automatic operations. 13-E four cylinder Waukesha engine. Comply with A. G. C. standards.

Subgrade Planers — Built for all types of roadway, 8′ to 27′ widths; attachable to 27-E Paver.

Construction Mixers — 14-S, 21-S, 28-S. Trucks or skids; rubber tires optional. 28-S skids only. Weigh Mix attachments on 14-S. Comply with A. G. C. standards.

Dandie Mixers — 5-S, 7-S, 10-S. 5-S single or four cylinder, 7-S two or four cylinder, 10-S four cylinder gasoline engine. Charging skip or low charging hopper and platform. Rubber tired or steel rimmed wheels. Comply with A. G. C. standards.

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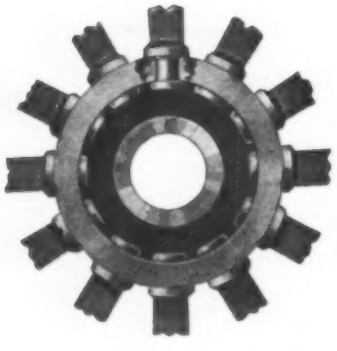
Wheel Specialization

WITHIN every factory and every department in a factory there is specialization. One man designs a better motor, another makes a better gear. Each becomes a specialist and the world profits by a better product.

French & Hecht specialize in the design and manufacture of Steel Wheels of all kinds—for Industrial Tractors, Road Machinery, Farm Implements, Motor Trucks and Busses, Trailers, Wheelbarrows, Carts and other equipment.

French & Hecht have specialized for years in the research and study of wheel application and engineering and have developed more steel wheels than any other organization in America.

So extensive are the experience and the facilities of this organization for the development and manufacture of steel wheels for all applications that French & Hecht service usually means a distinct saving to manufacturers, and always the assurance of superior wheels.



In French & Hecht Steel Wheels, each spoke is forged in the hub by a special process that expands the spoke in the hole to a perfect fit and at the same time forms a shoulder on the outside and a head on the inside. The spokes are fastened to the tire in a similar manner . . . French & Hecht is a distinct type of steel wheel. Many of its important features of construction and refinements are exclusive.

FRENCH & HECHT, Inc.

Wheel Builders Since 1888

Davenport, Iowa Springfield, Ohio

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STEEL WHEELS

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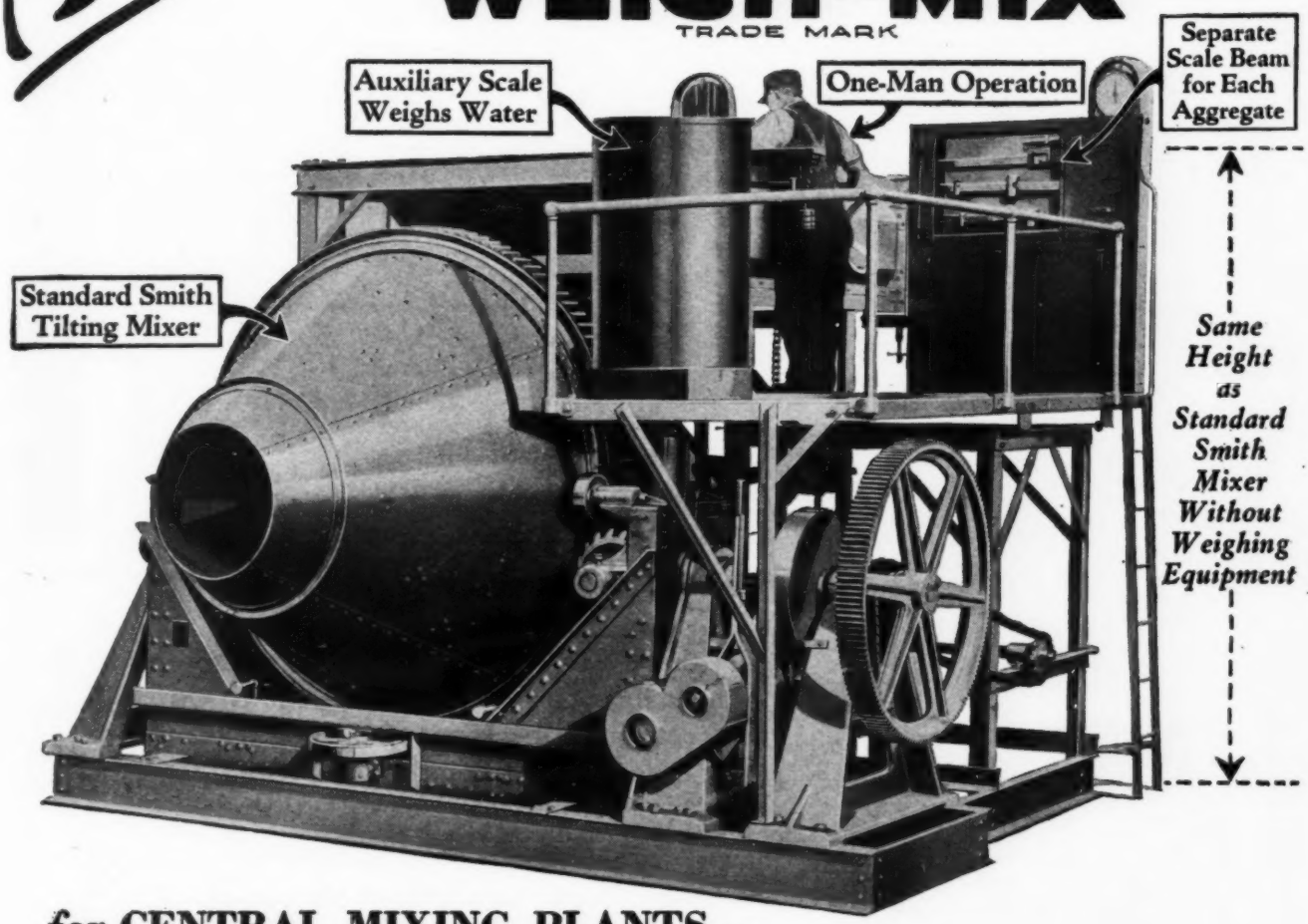
Announcing the New Smith WEIGH-MIX

TRADE MARK


Auxiliary Scale Weighs Water
One-Man Operation
Separate Scale Beam for Each Aggregate
Standard Smith Tilting Mixer
Same Height as Standard Smith Mixer Without Weighing Equipment

for CENTRAL MIXING PLANTS—

a complete self-contained manufacturing unit that accurately proportions ALL materials by WEIGHT and then thoroughly mixes them—Standard Smith Mixer and hopper used—No need for additional weighing hoppers—Vibrating device cleans hopper and allows scale to return to balance—Centralized control with one-man operation—a compactly built unit with fast portability—Easily applied to any of the larger size Smith Mixers in the field—Requires less capital and effects tremendous savings in operating costs. Write for complete descriptive information.

Weighs All the Aggregates -then Mixes!

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SMITH MIXERS

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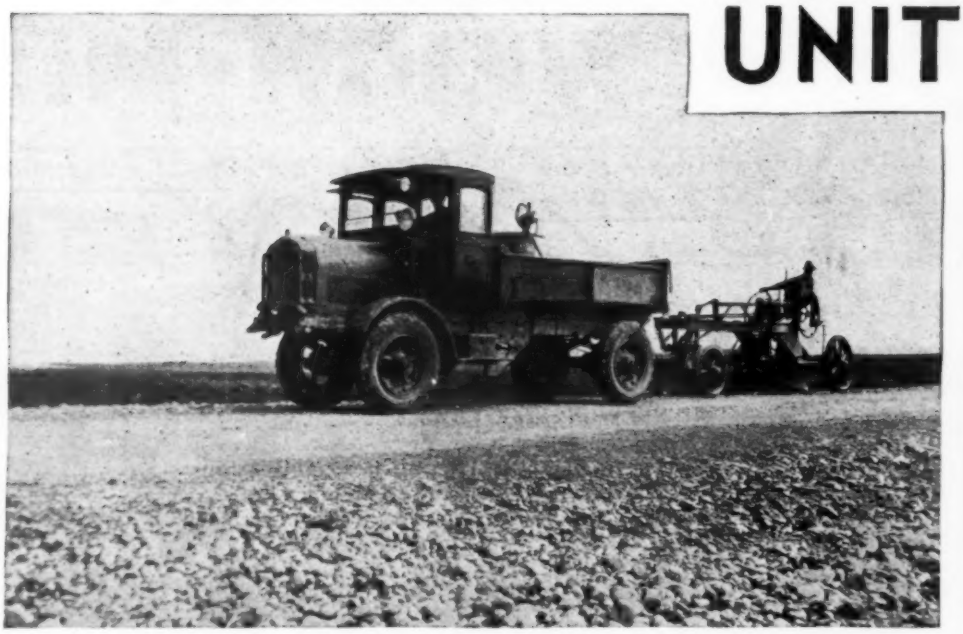
FWD most complete POWER UNIT



Send for this catalog which describes FWD Trucks as applied to road work in detail.

TWENTY-EIGHT STATE HIGHWAY DEPARTMENTS HAVE PURCHASED THEM

FWD Trucks are made in 2 to 10 ton sizes... four wheel trucks, six wheel trucks . . . tractor trucks.

IN the FWD Truck you get a complete . . . dependable . . . all-purpose power unit. One that will economically cope with the "toughest" of your road jobs . . . one that is built to stand the use and abuse of heavy service.

Put a FWD Truck to road building, maintaining, heavy hauling or any other of your work. Watch it *pull through soft, sandy, muddy* soils under capacity load. Measure its speed by the daily miles of road it maintains . . . then you will know what the FWD principle of distributing the load and power to all four wheels means to you in terms of money-savings.

FWD Engineers have designed and perfected a line of Trucks which will more dependably serve your field. Let us give you the *complete story.*

Write for specific folders today.

The Four Wheel Drive Auto Co.,
Clintonville, Wisconsin
Canadian Factory, Kitchener, Ontario

FWD

BACKED BY NATION WIDE SERVICE

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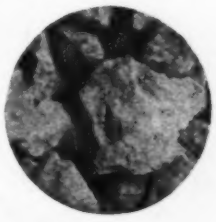
PIONEER GRAVEL EQUIPMENT

No. 10 Pioneer Screening, Crushing and Loading Plant, one man operated, hooked up with washed gravel plant for hard-surfaced roads, operating in Rutland Township, Barry County, Michigan. Inquiry as to the success of the hookup may be made to the plant owner, E. A. Campbell, Contractor, 920 W. Lovell Street, Kalamazoo, Michigan.

New Profits from New "Hook Ups"

The portability and economy of operation of Pioneer Screening, Crushing and Loading Plants is strikingly illustrated in the above picture. Here you see a No. 10 "Pioneer" Plant, hooked up with a washed gravel plant for hard-surfaced roads. The plant owner is thus able to obtain required crushed gravel capacities of fine or coarse, washed or unwashed aggregates in various uniform sizes, for either gravel or hard-surfaced roads. Long hauls are avoided. When the particular job is done, the Pioneer Plant is readily moved close to the next job wherever it is.



We manufacture a complete line of 11 different sizes of Crushing and Screening Plants, also Loading Plants, Drag Lines, Storage Bins, Conveyors, Shakers, Revolving Screens, etc.

Visit our exhibit, Atlantic City Road Show—January 13th to 18th, 1930

Write us your requirements.
We have distributor near you.

PIONEER GRAVEL EQUIPMENT MFG. CO.
MINNEAPOLIS, MINN.

Distributors and Service Stations everywhere.
Write for name and address of one nearest you.

THE Harahan Bridge, at Memphis, a combination railroad and traffic structure surfaced with more than 130,000 square feet of Carey Elastite Asphalt Plank.

Like a hundred others, it has the *Elastite* kind of a floor!

THE Harahan Bridge, at Memphis, carries an enormous shuttle of traffic over the Mississippi River between Tennessee and Arkansas. Yet its surface actually seems to *thrive* under this constant traffic tattoo.

For the Harahan Bridge is floored with *Carey Elastite Asphalt Plank*—more than 130,000 square feet of it! A dense, tough composition of asphalt, fibre and mineral matter, preformed into planks of required dimensions.

Grainless, decay-proof, even-textured, indifferent to extremes in temperature. And it actually knits and heals under traffic—compresses into a surface-smooth, unified, unbroken mass. Carey Elastite Asphalt Plank is easy to install over any smooth surface, with but little interruption to traffic.

Carey Elastite

ASPHALT PLANK

. . . for Bridge Flooring

THE PHILIP CAREY COMPANY, *Lockland,* CINCINNATI, OHIO

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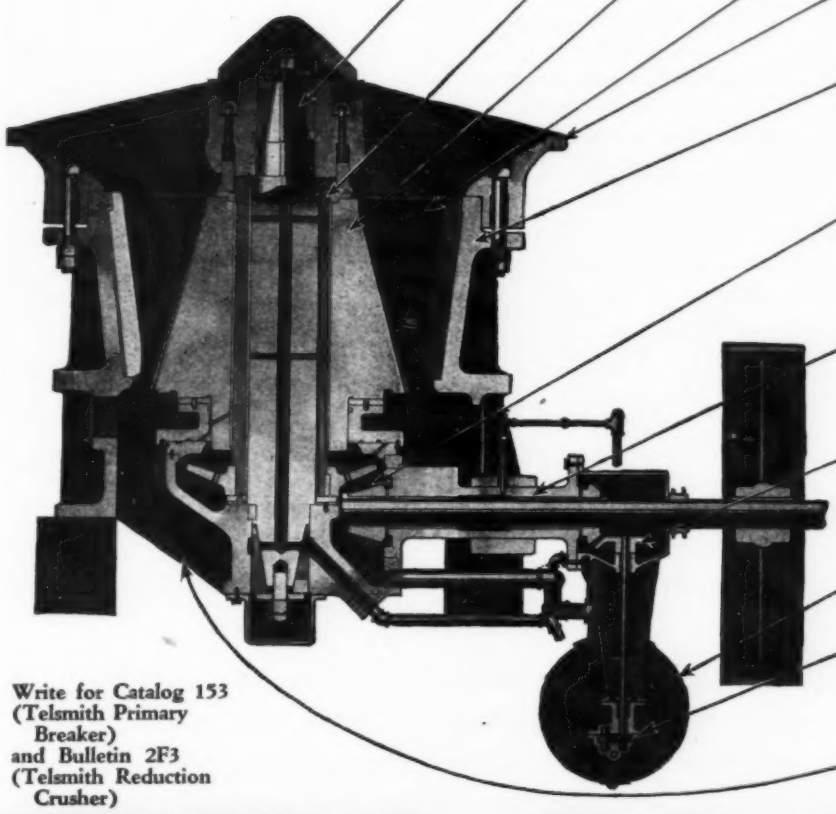
12 Reasons WHY Engineers Are Picking TELSMITH *Crushers*



1 Fixed shaft, guaranteed against breakage even by tramp iron. Held rigidly at top and bottom by expansible bushings. This shaft serves as a huge steel bolt through the whole crusher.

2 Long sleeve eccentric, rotating on fixed shaft. Eccentric bearings are three times greater than in other gyratory crushers. Renewable babbitt sleeves.

3 Crushing cone gyrates horizontally. The crushing pinch is as long at top of head as at bottom of the bowl. Exerts full stroke on the big chunks just as they enter crusher. Very little slippage even with gravel boulders.

4 Head and concave diameters are both greater than in other gyratory crushers, with consequent increase in receiving openings and crushing areas.

5 Low-arched, heavily metalled crown. Made of STEEL, guaranteed against breakage by tramp iron.

6 Frame is short—with thick walls and heavy ribs. It is made of STEEL, and guaranteed against breakage, even by tramp iron.

7 Steel drive gears, practically noiseless. Run in oil bath. Teeth never strip until worn out.

8 Removable countershaft box with renewable babbitt bushings, automatic lubrication and sight feed.

9 Pump drive gears are steel, completely housed with sight feed oiler.

10 Big oil supply tank, readily accessible and easily cleaned. Oil flow subject to instant inspection. All oil strained and cooled before re-use.

11 Gear oil pump. All bearings lubricated by oil under pressure, with perfect exclusion of dirt.

12 Clean discharge. No clogging. Discharge chute is independent of crusher structure, attachable at any position. No right or left-hand drive.

Write for Catalog 153
(Telsmith Primary Breaker)
and Bulletin 2F3
(Telsmith Reduction Crusher)

TELSMITH

Consult the nearest representative or write or wire direct to TELSMITH.

CANADIAN REPRESENTATIVES: Canadian Ingersoll-Rand Co., Ltd., Montreal, P. Q.

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Borchert-Ingersoll, Inc. St. Paul, Minn.	V. L. Phillips Co. Kansas City, Mo.	G. R. Mueller Co., Birmingham, Ala.	V. L. Phillips Co., Oklahoma City, Okla.	Choctaw C. & M. Co. Memphis, Tenn.

SMITH ENGINEERING WORKS

B-8

82 CAPITOL DRIVE MILWAUKEE, WISCONSIN

Strengths You Can Depend Upon

Tests on 7 Recent *High-Early-Strength Universal* Concrete Jobs

Kind and Location of Work	3-day Compressive Strength lb. per sq. in.	Testing Laboratory	Engineer and Contractor
Concrete as commonly mixed and placed for pavement work.	(1500)		
3-day strength designed on the following 3 jobs:	(2800)	U. P. C. Co.	
Scale Pit Duluth, Mesaba & Northern R. R. Proctor, Minn.	3430	Minnesota Steel Co., Duluth	E. H. Dresser, Chief Engineer, D. M. & N. R. R.; Peppard & Fulton Co., Superior, Wis., contractor
Pavement Repairs Delaware Ave., Tonawanda, N. Y.	3085	Hallenbeck Inspection and Testing Laboratory, Buffalo	Geo. C. Diehl, County Engineer, Erie County, N. Y.
Industrial Driveway Consolidated Company, Chicago	3140	Robert W. Hunt Co., Engineers, Chicago	Construction by Consolidated Co.
3-day strength designed on the following 4 jobs:	(2400)	U. P. C. Co.	
City Pavement State Street, Hammond, Ind.	2531	Robert W. Hunt Co., Engineers, Chicago	Ray Seely, City Engineer, Ahlborn—Lavene, Construction Co., Hammond, Ind., contractor
Industrial Driveway Standard Oil Co., Batavia, N. Y.	2485	Henry L. Howe. testing engineer, Rochester, N. Y.	Ray F. Otis, engineer; James A. Crelley, contractor, both of Batavia, N. Y.
City Pavement La Salle Street, Chicago	2400	Portland Cement Association, Chicago	John A. McGarry & Co., Chicago, contractors
City Pavement Washington, Pa.	2670	Standard Inspection Co., Pittsburgh	Consolidated Engineering Co., Wheeling, W. Va., contractor

High-Early-Strength Universal Concrete, in addition to its dependable strength, is both more watertight and more durable than ordinary concrete. It is obtained with the same Universal portland cement used for regular work by the application of tested mixing and placing methods. No special materials or cement are required. Full description of these methods will be sent on request. Just use the coupon.

Name _____

Address _____

Universal Portland Cement Co.
208 So. La Salle Street, Chicago
Without obligation, please send me booklet giving full details for securing strong concrete for in 3 days with the usual materials and labor.

R & S 12-29

Universal Portland Cement Co.

Subsidiary of United States Steel Corporation

Chicago Pittsburgh Minneapolis Duluth Cleveland Columbus New York

Concrete for Permanence

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MILLIONS LOST ON BAD ROADS

Automobiles in the United States travel 110,000,000,000 miles a year. According to the best estimates available, not more than half this mileage is over substantially surfaced roads. Measured by well established tests, driving expense over roads not yet surfaced to the point where vehicle operating costs may be reduced to bedrock is approximately one cent a mile greater than on substantially surfaced roads.

Putt... facts together, it is evide... ha... roads over whic... smod... the ... be s... T... bui... cou... ha... da...

Coating of Tar Kills Dust; Athens Nearer.

NELSONVILLE, Aug. 1.—"Out where the dust begins" is a slogan that no longer applies to The Plains. This Athens County community has been lifted definitely from the dust zone. By Sunday The Plains route will be safe for motorists, according to County Engineer "Dike" Wilson.

People who have never resided on a gravel or limestone highway since the era of the automobile have ... of what ... all means. According to the county engineer, statistics show that between 200 and 300 tons of roadway per mile is carried away yearly in dust from this type of highway under modern traffic co... ... county roads has become an annual pastime. Considerable of this tonnage that blows away settles on the homes of adjacent property owners; it sifts through the window cracks and under the doors; it ruins curtains, rugs and dispositions. Folks down The Plains way were getting out their rocking chairs and erecting swings on the front porches yesterday. They are getting ready to enjoy life again down in that dust-emancipated section.

The Plains road, a county thoroughfare, leaves State Route 31 at Beaumont and connects with State Route 56 at the Herrold Mill bridge ... ... in length. It has been permanently improved at an approximate expenditure of $2,600 per mile. Limestone used on the improvement cost ... ... gallons of tar has been distributed.

EVERYWHERE A "GOOD ROAD" FAMINE . . .

Everywhere there are communities which have no share in this vast era of good roads. A billion and a half is spent each year on highway construction and maintenance and yet *they* still wade through the mud in winter and see their homes and fields blanketed with dust in summer.

Read that homely line in the news from Nelsonville after their road was surfaced with Tarmac: *"Folks down The Plains way were getting out their rocking chairs and erecting swings on the front porches yesterday. They are getting ready to enjoy life again down in that dust-emancipated section."*

Limited mileages of high-cost surfaces have often monopolized highway appropriations. It is now apparent that it will be impossible to surface our vast mileage of roads unless we establish a balanced budget to permit the building of greater mileages with those types which are more economical to construct and yet carry the traffic under all conditions.

With Tarmac you can pave five or six times as many miles, with the same appropriation. Let us send you information about Tarmac.

AMERICAN TAR PRODUCTS COMPANY

General Offices: KOPPERS BUILDING, PITTSBURGH, PA.
New England Division: Tar Products Corporation, Providence, R. I.

PLANTS

Chicago, Ill.	Utica, N. Y.	Providence, R. I.	Follansbee, W.Va.
Milwaukee, Wis.	Birmingham, Ala.	Kearny, N. J.	St. Louis, Mo.
Youngstown, O.	Hamilton, O.	St. Paul, Minn.	New Haven, Conn.

"The Plains" Road, Athens Co., Ohio, surfaced with Tarmac. Read the newspaper clipping which tells what that road means to the people who live along it.

Tarmac

MAKES GOOD ROADS

Visit the Tarmac booth at the Road Show of the American Road Builders' Association, Atlantic City, January 13 to 18.

The City of Syracuse, with snow tying up traffic, called on Universal Truck-Cranes to remove the snow. They did—in a hurry—and saved the city $2.00 a truck load.

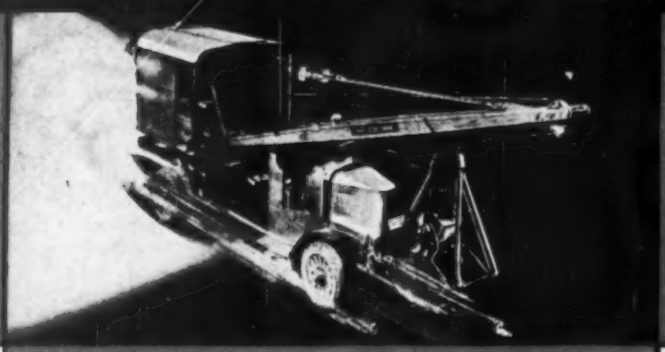
$1211.00 in August; $1063.00 in September; $1037.00 in October—this is the record of earnings of one of the six Universal Truck Cranes owned by an Ohio Crane Service Co.

WITHIN a radius of 50 miles of your headquarters there are, right now, a practically unlimited number of "short crane jobs," that a Universal Truck Crane will handle at a profit to yourself. ¶ These photographs show a few of the types of jobs, on which Universals earn real money.

THE UNIVERSAL CRANE COMPANY · *Lorain, Ohio*

1930 CONVENTION ROAD SHOW A.R.B.A. ATLANTIC CITY JAN. 13-18

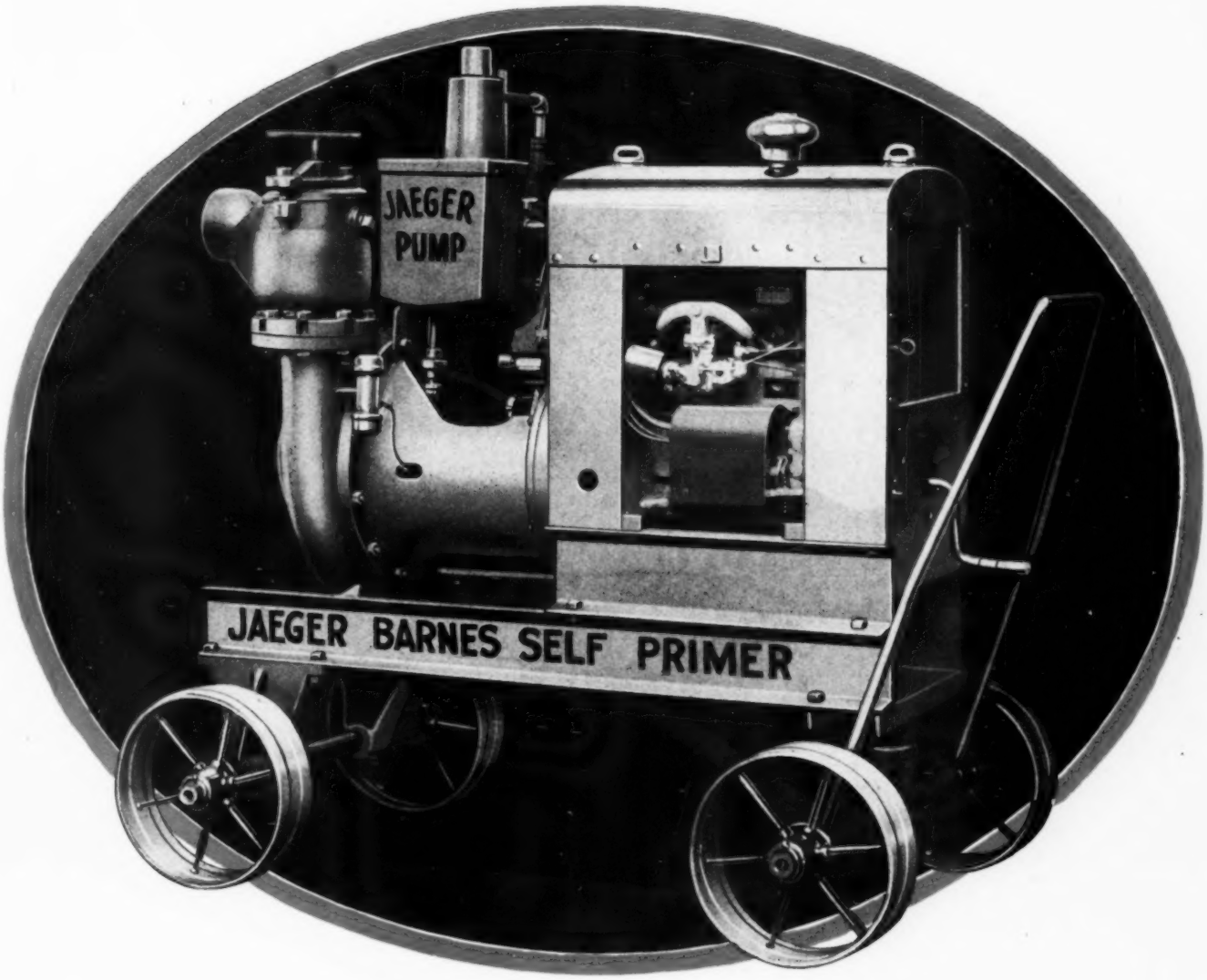
Making mobility count .. on the way to a basement excavation job, this Universal Truck Crane stopped long enough to place a chimney stack, earning $25.00 extra in less than 2 hours.



Money saved for the factory owner, money earned for the Truck Crane owner .... this Universal cut the cost of loading iron scrap, handling the material with a clamshell bucket.

With the traveling speed of a truck, and the versatility of a ½ yd. crane, Universals make a specialty of handling "short crane jobs" at a profit. You can rent these machines from any of the Crane Service Companies located throughout the United States.

UNIVERSAL

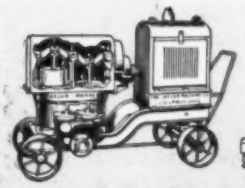


Always Ready to Pump

Priming and Foot Valves are Abolished with this 100% SELF-PRIMING Line of Centrifugals

All advantages of other types... plus 3 times their capacity! Lift of 27 ft.... 5 to 10 ft. more than ordinary centrifugals! Muddy water won't clog it! Absolutely automatic... maintains continuous high vacuum! Primer *increases* lift and volume! Simplest vacuum pump ever designed... just *one* moving part! All working parts run in oil bath! Sizes for biggest and smallest jobs... with gasoline or electric motors.

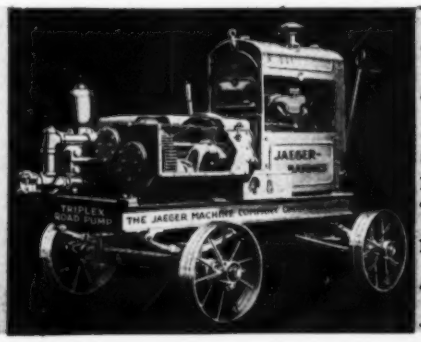
Get new 1930 prices on Jaeger-Barnes line of TRIPLEX ROAD PUMPS DIAPHRAGM, PLUNGER and CENTRIFUGAL PUMPS!



DIAPHRAGM PUMPS

PLUNGER PUMPS

TRIPLEX ROAD PUMPS



JAEGER MIXERS-PUMPS HOISTS—Information Slip

The Jaeger Machine Company
223 Dublin Ave., Columbus, O.

Send catalog and prices on

Pumps ☐ Non-Tilt Mixers ☐
Tilters ☐ Timken Roller Hoists ☐

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The DIESEL GIANT WORKS *for* LOW WAGES

DIESEL POWER is a giant. No other internal combustion power is so mighty. No other internal combustion power can give you such huge shovel output. Yet this giant works for low wages . . . costs 75 to 85% less than gasoline power. For P & H Diesel engines require but half as many gallons of fuel as gasoline engines—fuel costing only one-third to one-half as much per gallon.

And Diesel Power, this giant that works for low wages, has a feature not possessed by other types of internal combustion power. Its torque increases when slowed down below 50% of normal speed in heavy digging. It gives you most when you need most. That means increased yardage . . . 10 to 15% more in heavy service. These machines are built in sizes from 1 to 3½ cubic yards capacity. Send for special Diesel folder. HARNISCHFEGER CORPORATION, 3896 National Avenue, Milwaukee, Wisconsin.

1930 CONVENTION & ROAD SHOW A.R.B.A. ATLANTIC CITY N.J. JAN. 13-18

P&H *Diesel* EXCAVATORS

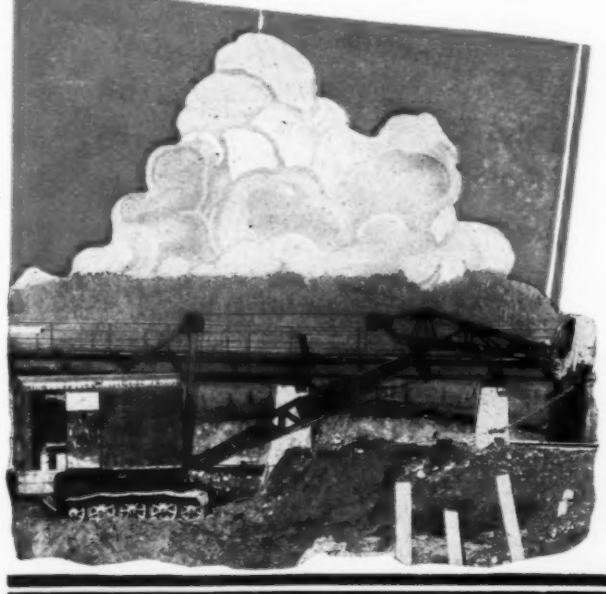
now it's

LIMA "101"s

for

J.A.LAPORTE CORPORATION

The LIMA "101" is the only shovel in the world equipped throughout with roller bearings. A Timken at every vital bearing point.



"Not a dollar for repairs in seven months" is one of the reasons J. A. Laporte Corporation, of Wassaic, New York, bought their second LIMA "101."

Performance counts and LIMA "101" records in all sections of the country are building unequalled excavator records.

Send for a copy of Bulletin 291 which illustrates and describes the many advanced features found in Lima Shovels, Draglines, Cranes and Dragshovels.

The Ohio Power Shovel Co.

Division of Lima Locomotive Works, Inc.

LIMA, OHIO, U. S. A.

Western Office
846 Straus Bldg., Chicago

Eastern Office
2351 Graybar Bldg., New York

The Ohio Power Shovel Co. is represented throughout the United States by reliable equipment dealers. Write us for the name of the one nearest you.

mail the Coupon NOW!

The Ohio Power Shovel Co.
Lima, Ohio
Gentlemen: Send me further information about the Lima "101"

Firm name.....

By .....

Address .....

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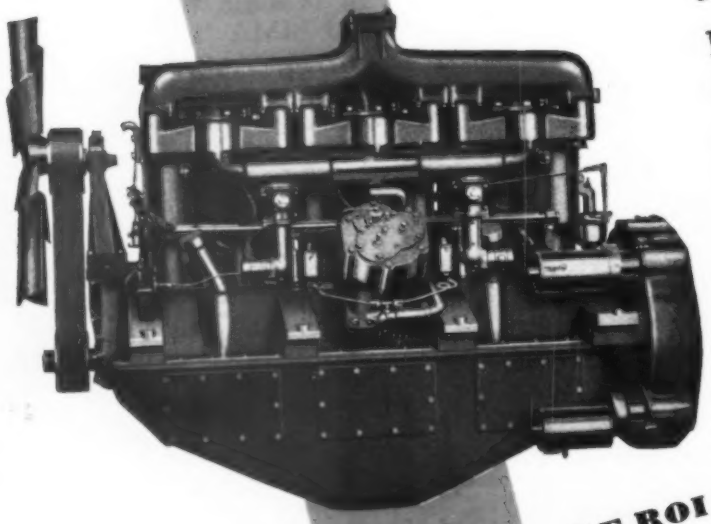
Nature of work.....

Power



SMOOTHER power, more economical power, surplus power—that's what the Le Roi Engine provides. It boasts of greater flexibility, greater acceleration and less vibration.

It's the power that gives *action* to most construction jobs—the power upon which the majority of contractors depend for profit.

Le Roi's the *power* of wide acceptance and second to none for economy of operation.

LE ROI COMPANY, Milwaukee, Wis.

LE ROI ENGINES

3 to 170 HORSE POWER

PUSHING THROUGH WITH A General

With its unceasing, indomitable power, the GENERAL drives steadily and speedily forward pushing through the toughest jobs to a profitable completion.

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CONVERTIBLE

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DISTRIBUTORS IN PRINCIPAL CITIES
GENERALS
EVERYWHERE

THE GENERAL EXCAVATOR CO.
MARION, OHIO
200-277 ROSE ST.

ROADS AND STREETS
Design, Construction, Maintenance and Traffic Control
November, 1929
W. P. Gillette, Editor
Vol. LXIX. No. 11
Russell Motor Patrol Graders Are
bearing that does all things well.
THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO
TIMKEN Tapered Roller BEARINGS

There's Only One Road Show Issue

Is Your Space Reserved?

Put Your First 1930 Message Over the Top in January ROADS AND STREETS

Total Circulation 27,000, Certified Audit of Geographical Distribution and Occupational Analysis

Editorial pages, advertising pages, devoted entirely to roads and streets. Detailed descriptions and illustrations of Road Show Exhibits. Statistics of 1929 Construction and Outline of work for 1930.

100% For Highways

Forms Close December 20th

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Executive and Editorial Offices: 221 East 20th Street, Chicago

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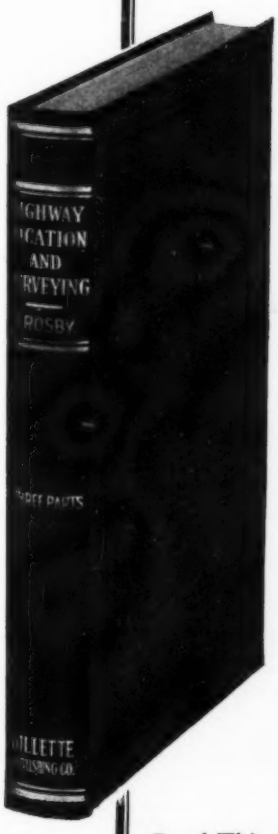
HIGHWAY LOCATION *and* SURVEYING

by

W. W. Crosby, B.C.E., C.E., D.Sc., D.Eng.F., A.A.S., F.R.S.A., Mem. A.S.C.E., etc.

George E. Goodwin, Mem. A.S.C.E., Mem. Am. Assoc. Eng. Formerly Chief Civil Engineer, National Park Service U. S. Department of the Interior.



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an Up-to-the Minute Viewpoint on

HIGHWAYS

Out of a wide experience these authors present to you some theory and a great deal of practical material, including accurate graphs, tables, diagrams and pictured examples. Just published, this book makes its points with a full awareness of modern high speed highway requirements. It is free of the handicap of many works on this subject, written only a few years ago, without knowledge of today's conditions.

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Book II Notes on Mountain Highway Location. Controlling Factors, Kinds of Surveys, Structural Considerations, General Standards, Estimates, Costs of Making Surveys, Etc., General Instructions to Engineering Assistants.

Book III Notes on Highway Surveying.

You May Inspect the Book with This Coupon

Gillette Publ. Co.
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Please let me read Highway Location and Surveying as you suggest. Send the book postpaid on 5 days' free trial. At the end of that time I will return the book, postpaid, or remit $5 and keep it.

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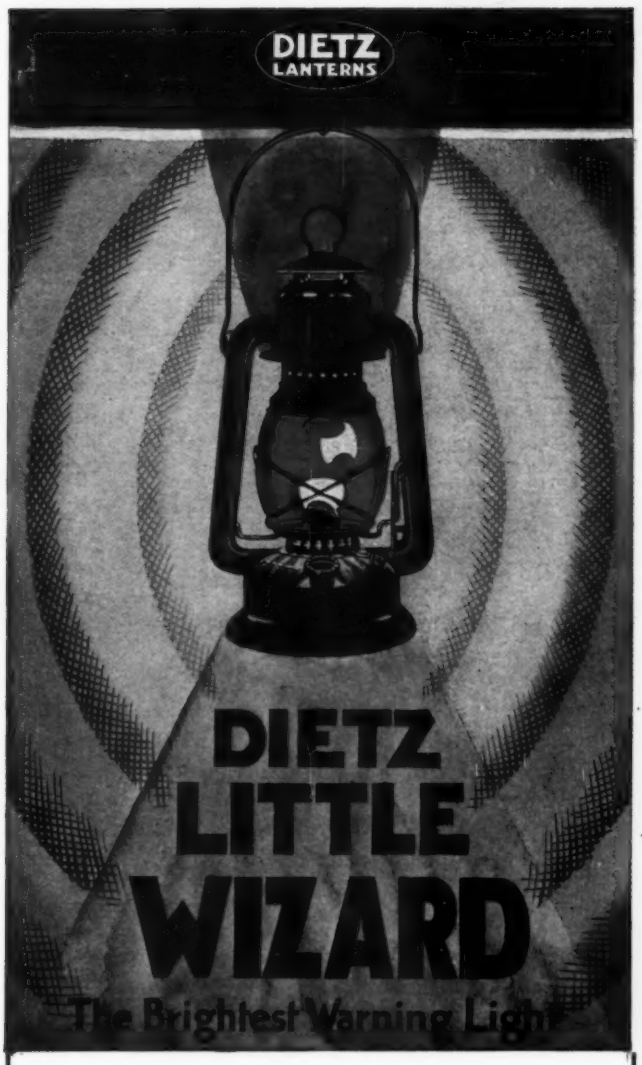

AMONG all the confusing traffic and danger lights seen along the highways there is one—perhaps only one—which is *universally* understood.

THAT is an inexpensive RED Lantern—made by DIETZ.

And because a brighter red light affords greater protection to all concerned, many highway, water works and sewer contractors use Dietz Cold Blast LITTLE WIZARD—the little lantern with the big light—always dependable.

R. E. DIETZ COMPANY

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Largest Makers of Lanterns in the World

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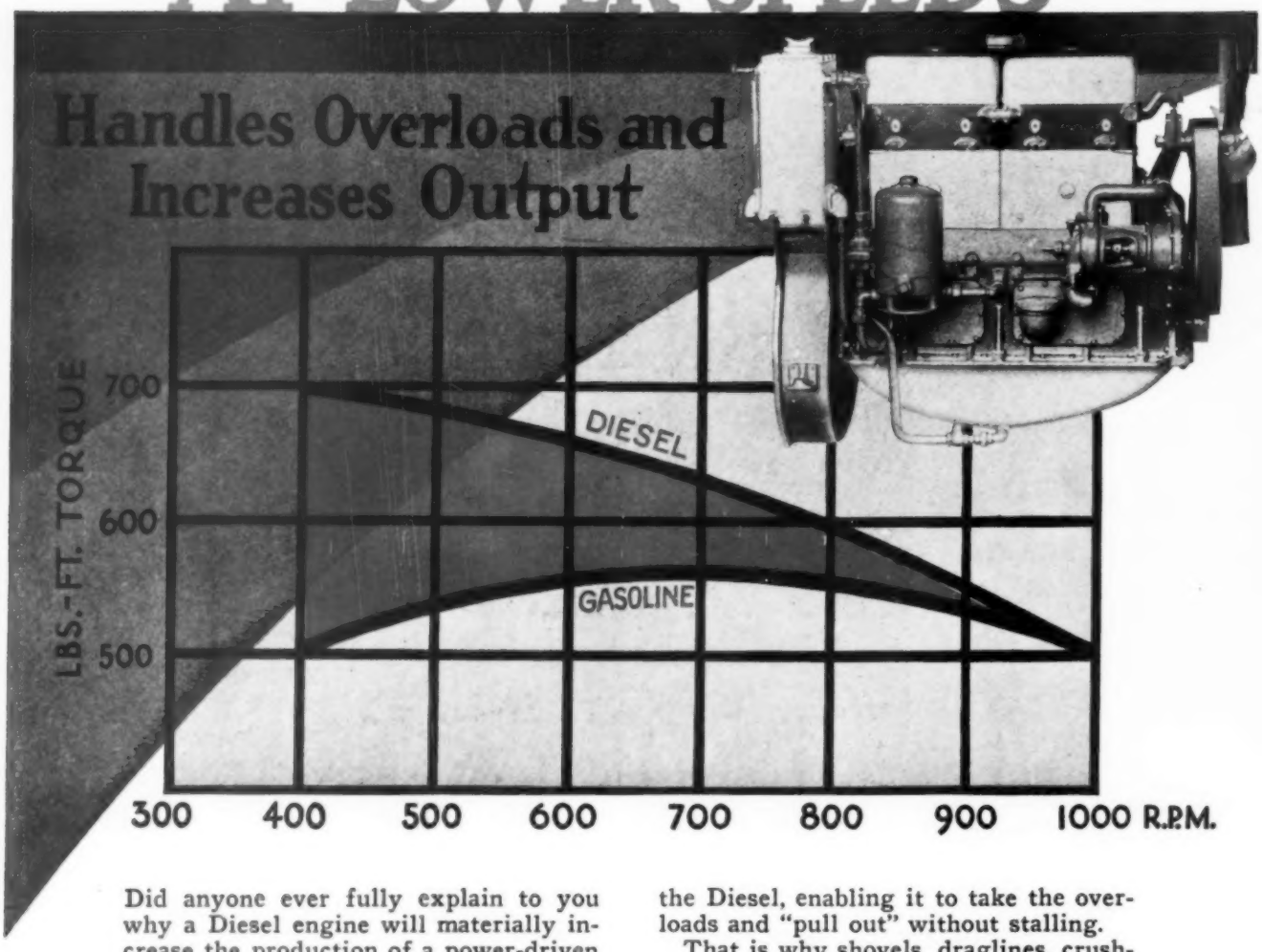
GREATER TORQUE AT LOWER SPEEDS



Did anyone ever fully explain to you why a Diesel engine will materially increase the production of a power-driven machine?

It is primarily a matter of torque at speeds less than the normal operating speed. This point is illustrated graphically by the above curves, which show the superior torque characterictics of a Buda-M.A.N. Diesel engine, as compared with a heavy-duty gasoline engine of equal horsepower rating. The area (in red) between the curves represents the amount of reserve power possessed by the Diesel, enabling it to take the overloads and "pull out" without stalling.

That is why shovels, draglines, crushers and other mobile and stationary equipment powered with the 92, 120 or 180-hp. Buda-M.A.N. Diesel are giving as high as 15% greater production, and giving it day in and day out.

It will pay you to specify Buda-M.A.N. Diesels. Use the coupon and enclose an outline of your power requirements, so that detailed information can be sent to you.

THE BUDA COMPANY

HARVEY (Chicago Suburb) ILLINOIS

BUDA
M.A.N.
DIESEL
POWER

RS1229

THE BUDA COMPANY, Harvey, Ill.
Send me bulletins and detailed information on Buda-M.A.N Diesel Engines.

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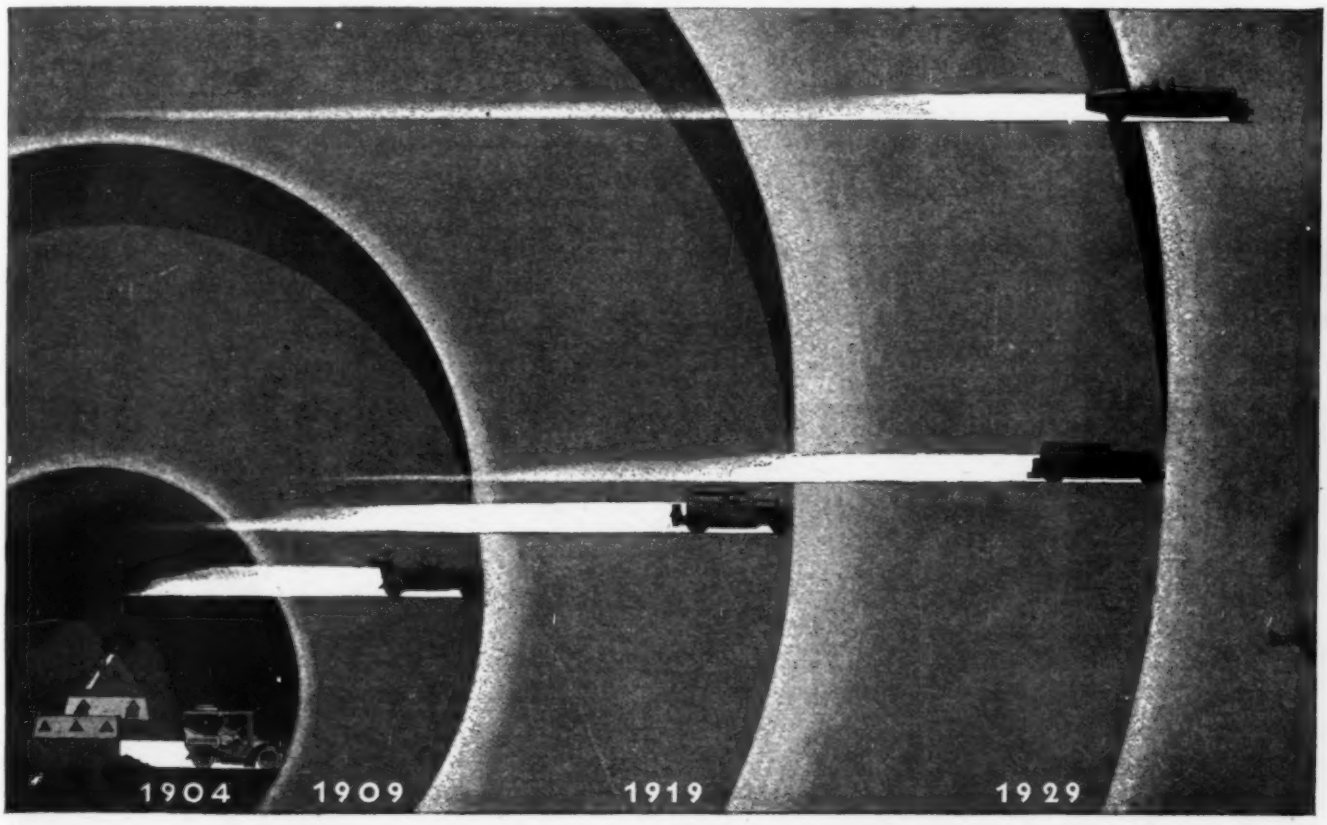
Company.....

City.....

State.....

« *Ever-lengthening* Radii »



TEN years ago, the average day's run of the motor tourist was 110 miles. Today it is 234 miles. There are not a few purposeful pilots who do 500 miles in a single day's going. What a contrast with 1909—when our country consisted largely of people limited to a daily radius of 15 miles!

Automobiles and roads have become a great determining factor in social life, farm prices, property values . . . even the stock market. Roads constitute the warp into which modern transportation has woven the new prosperity.

But automobiles are increasing faster than pavements. More and wider roads—not just more and faster automobiles—are needed.

There need be no waiting—no burdensome financing—if your community adopts a Tarvia program. Twenty-five years of low-cost construction and economical first-class performance have proved Tarvia. It is the road enabling maximum economy in use of local materials—equal to every traffic requirement—long-lasting, skid-safe and smooth.

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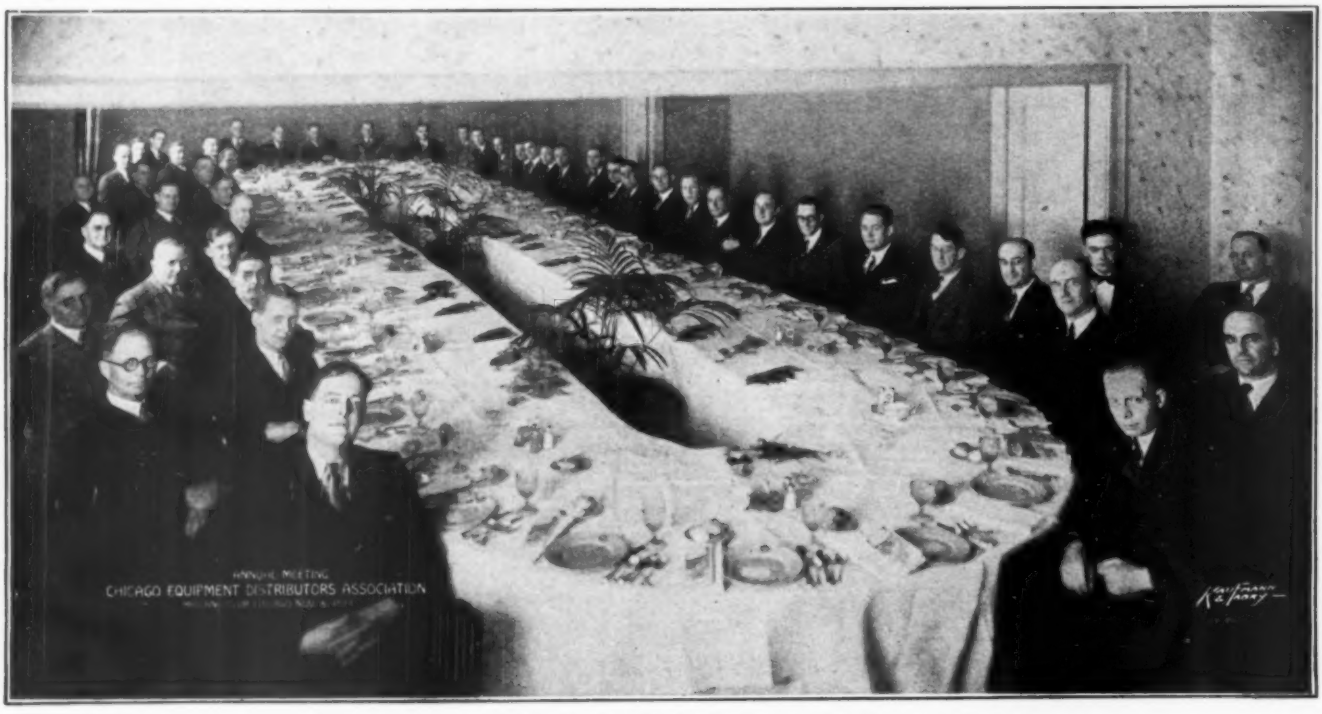
Tarvia
FOR ROAD CONSTRUCTION
REPAIR and MAINTENANCE

DISTRIBUTOR NEWS

The Distributor's Department in the Gillette Construction Group



Annual Meeting, Chicago Equipment Distributors' Association, November 8, 1929

A Banquet of Food and Harmony

The Chicago Equipment Distributors' Association celebrated its second birthday, Friday, November 8th, with a banquet at the Midland Club, Chicago, with a reported attendance of 100 per cent.

In describing the scene we quote one of the members who was present:

"What a sight for the eye! Contractors' Equipment Distributors of Chicago breaking bread and drinking distilled water at one time in one place in perfect harmony."

The president of the association presided, outlined the work accomplished during the first two years and anticipated accomplishments to come.

The Chicago Equipment Distributors' Association is an Illinois corporation organized not for profit. In laying the foundation for this association the members believed that the manufacturers whom they represent, the people they serve and the distributors, themselves, would all profit by adopting a systematic plan for bringing the distributors in the Chicago territory together in a spirit of cooperation to advance the interests of all concerned.

One of the members speaking for the association said: "In this day and age better business methods are demanded by both buyer and seller. The latter must represent his Company one hundred per cent, he must stick to the truth and above all be a man and a salesman. All distributors' representatives must be educated to know their products better and the application in such a way as to have and hold the confidence of the prospective buyer."

To accomplish these aims and bring the equipment distribution business to its highest point of service explains the purpose of the association. Several speakers took part in the annual meeting which closed with an expression of confidence in the success of the undertaking.

William Ogden Made Manager of Highway Industries

Believing that there are a number of lines of work throughout the year whereby the Manufacturers' Division of the American Road Builders' Association may serve their members to advantage, a plan has been adopted for closer cooperation in development of the affairs of this division, and Mr. William Ogden has been appointed as manager.

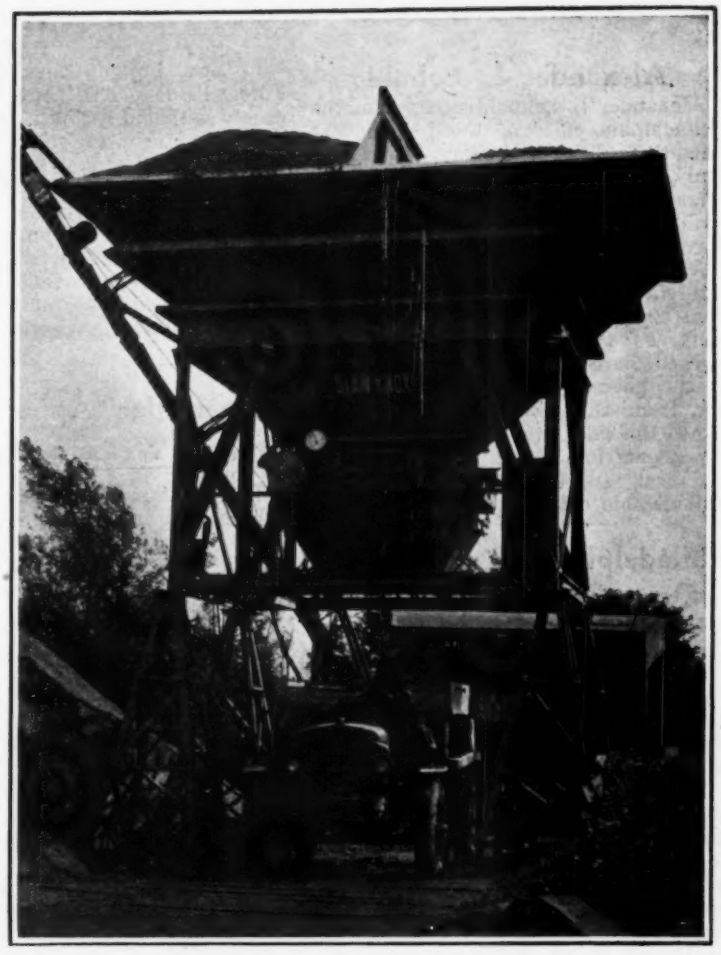
In a statement issued by Mr. P. L. Griffiths, president of the Manufacturers' Division, he said: "Mr. Ogden will devote his full time to the work of the division and will be the representative of the highway industries at the headquarters of the American Road Builders' Association. As such he will develop and carry on, under the supervision of your executive committee, such activities as may be of value to the manufacturers of equipment and materials used in the road building industry."

Mr. Ogden was appointed at the time the Highway Industries group met in Atlantic City for allocation of road show space, and he is now established in permanent headquarters in the Washington offices of the Road Builders' Association, National Press Building, Washington, D. C. It is stated that he will travel extensively among manufacturers and members of the highway industry.

For many years Mr. Ogden was associated with the Austin-Western Road Machinery Company and the Lakewood Engineering Company and brings to his new position a wealth of experience in the highway field. He has a nation-wide acquaintance among State highway engineers and other road officials and builders.

Weighing BATCHER *Plants*

This 100-Ton Blaw-Knox WEIGHING BATCHER-PLANT is an efficient and dependable unit in the road building organization of M. Bennet & Sons, Indiana, Pa.

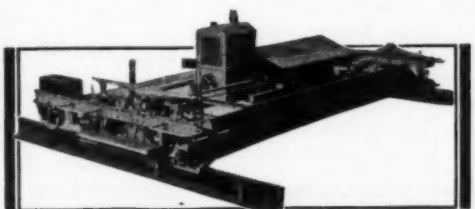


Blaw-Knox WEIGHING BATCHERPLANTS are playing an important part in the road building programs of 1929 throughout the country.

Contractors everywhere prefer Blaw-Knox Weighing Batcherplants because they are designed by engineers who know what the contractor wants and needs.

Self-Cleaning; portable; equipped with accurate and speedy WEIGHING BATCHERS for the weighing of one, two or three materials. The operator watches the TELL-TALE DIAL and checks every batch for over-weight or under-weight.

Meet Us at the 27th Annual **ROAD SHOW** Atlantic City Auditorium Jan. 11 to 17, 1930



The **ORD Road Finisher**

"It's the double sliding screed that does it.

Blaw-Knox WEIGHING BATCHERPLANTS are made in a complete range of types and sizes, fully described in Bulletin No. 1105. *MAIL THE COUPON for your copy.*

BLAW-KNOX COMPANY
2003 Farmers Bank Bldg., Pittsburgh, Pa.

Send me a copy of Bulletin No. 1105-Blaw-Knox WEIGHING Batcherplants

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COMPANY .....
STREET .....
CITY ..... STATE .....

TRADE MARK REG. U.S. PAT. OFFICE BLAW-KNOX

BLAW-KNOX

Alexander L. Schuhl

Alexander L. Schuhl, manager of the Philadelphia office of the Independent Pneumatic Tool Company, died suddenly, of pneumonia, on October 20th, after an illness of only a few days. Mr. Schuhl was born in Philadelphia, May 25th, 1884.

After finishing school, Mr. Schuhl entered the services of Wm. Cramp & Sons Ship and Engine Building Company, as a machinist apprentice and worked there until he became foreman of the pneumatic tool room. Resigning from this company in 1917, he joined the sales organization of the Independent Pneumatic Tool Company, and was appointed manager of the Philadelphia office in 1924.

Philadelphia Quartz Company Opens Plant in Baltimore

Establishment of a branch plant in Baltimore by the Philadelphia Quartz Company, 121 S. Third street, Philadelphia, for the manufacture of silicate of soda has been announced by H. Findlay French, director of the Industrial Bureau of Baltimore.

The Philadelphia Quartz Company is stated to be the oldest and largest producer of silicate of soda in the country. It will celebrate its 100th anniversary in 1931. Its Baltimore plant, work upon which will begin immediately, will be situated upon a four-acre tract of land in Locust Point, at Fort avenue and Decatur street.

Silicate of soda is one of the raw materials for the Doucil water softner, and it is a valuable means for controling rusty water in the home or in the city supply. A special form serves as a hardener for concrete roads and still others to make cements for resisting acids and other needs of chemical manufacturing.

The company's general office is located at Philadelphia, Pa., and it now has factories at Rahway, N. J., Chester, Pa., Gardenville, N. Y., Anderson, Ind., Kansas City, Kansas, St. Louis, Mo., Utica, Ill., and the Phila. Quartz Co. of California, Berkeley, Cal.

Young Radiator Reports Peak Production

The Young Radiator Company of Racine, Wis., manufacturers of copper heat transfer products, reports it has reached its peak production of industrial type, internal combustion engine cooling radiators for trucks, power units, compressors, industrial machinery, hot water forced draft automobile heaters, and new type forced draft heating units for factories and buildings.

Mr. F. M. Young, president of the company, states that plans are underway to double the manufacturing possibilities during the coming year, and that much additional machinery looking toward increased production has already been installed.

In speaking ot the business, Mr. Young said: "This company has purposely withheld accepting certain large contracts due to its desire to take care of its established trade which is known to fluctuate, but with the additional equipment at least two times the previous production can be attained. Increase in accounting, purchasing and engineering department personnel has also been made to promptly take care of, and control the additional work."

"Caterpillar" Appoints Chambers Western Manager

H. H. Chambers, former assistant sales manager of the eastern territory, has been appointed sales manager of the western division with headquarters at San Leandro, California, for the Caterpillar Tractor Company.

H. H. Chambers, Newly Appointed Western Sales Manager for Caterpillar Tractor Co.

Mr. Chambers succeeds I. E. Jones, who according to announcement issued by the company, is embarking on an extended trip through foreign lands in the interests of the export sales division. E. I. Stoffer, former district representative in Pennsylvania and New York for Caterpillar, will take Chambers' place in the eastern division.

The appointment of Mr. Chambers to his new position is announced as a promotion, his connection with the company having started fourteen years ago as a laborer on the assembly line, where he spent three years. He served in the army during the World War and rejoined the Caterpillar company as a member of the sales promotion and advertising department. Later he spent three years as salesman and general manager for a Wisconsin Caterpillar dealer.

Milwaukee Firm Makes Big Gravel Plant Shipment to Russia

The Amtorg Trading Company, said to be official purchasing agents for the Russian Soviet Government, placed an order with the Smith Engineering Works of Milwaukee, for eight carloads of gravel plant machinery, which has recently been consigned to Soviet Russia.

The plant will be placed in operation next spring and will furnish material for the construction of an 80,000 kw. hydro-electric plant near Leningrad. According to announcement, the plant when completed will be the largest one outside of the United States.

Two units with a washing and screening capacity of 300 cu. yd. an hour, each, make up the plant. The main washing and screening cylinders of the Telsmith Hercules washing screens are 72 in. in diameter by 24 ft. long, while the sand jackets are 99⅝ in. in diameter, by 14 ft. in length. Each of these screens weighs 30,000 lb. and has a capacity of 300 yd. per hour. The screens are equipped with Timken tapered roller bearings which greatly reduce the frictional load. A man of ordinary strength is said to be able to turn the screen by hand.

Whitcomb Company Expand

The Geo. D. Whitcomb Company of Rochelle, Ill., announces the completion of a new factory addition to be used primarily for the manufacture of large oil-electric and large gear drive locomotives.

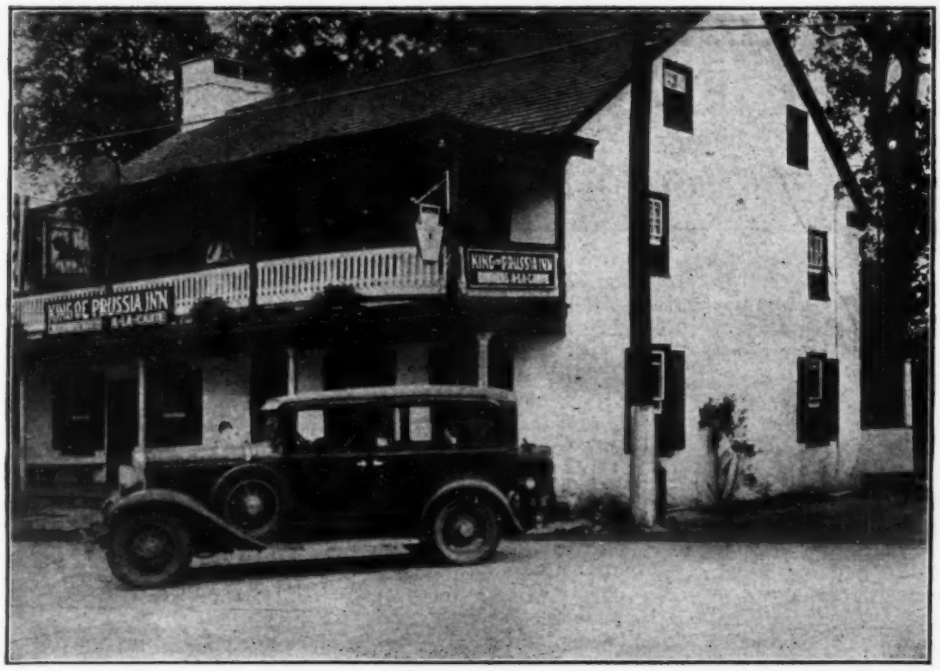
According to announcement the expansion is due to the increased business of the company, and they contemplate another addition to the office at an early date, as well as a plant extension during the early part of the coming year.

The Whitcomb Company manufactures modern motive power and has a complete line of gasoline, distillate, diesel, trolley, storage battery and oil-electric locomotives in sizes from 2 to 100 tons.

Eastern Manufacturer Returns from Southwestern Trip

Mr. Earle S. Philips, vice-president of the Good Roads Machinery Company of Kennett Square, Pa., has recently returned from an extended business trip into the southwest section of the country, his objctive being San Antonio, Texas. Mr. Philips reports conditions very good indeed in the southwest, and he is anticipating a good fall and winter business from that section.

During the trip Mr. Philips visited the Muskogee Iron Works Company of Muskogee, Okla.; J. B. Harbison Equipment Company of Little Rock, Ark., and C. P. Hollingsworth, San Antonio, Texas.



Placed Saturday Afternoon— Opened to Heavy Sunday Traffic

AT King of Prussia, on the outskirts of Philadelphia, two heavily-traveled highways cross the road connecting Paoli and Norristown. This is historic country; the old Inn at King of Prussia (shown above), built in 1709, serves the motorist today just as it served the traveler in the Revolutionary days when General Washington led his troops past its doors on march to Valley Forge.

To avoid troublesome detours and the expense of building temporary bridges while repaving these two intersections, the Golden Contracting Company, contractors for the repaving, used "INCOR" Brand Perfected High-Early-Strength Portland Cement. The concrete at both intersections was ready for traffic within 24 hours after placing. The photograph reproduced above shows a car moving over "INCOR" concrete less than 24 hours old.

Indeed, to avoid delays to heavy Sunday traffic, one-half of one of the intersections was placed on Saturday afternoon and opened next day in time to help the Sunday drivers get back home in comfort.

"INCOR" makes 24-hour concrete practical. The rugged permanence and dependability of Portland cement concrete is assured, for "INCOR" is a Portland cement.

Use LONE STAR Cement for all concrete construction work where time is not the principal factor. When time means money, it pays to use "INCOR"* Brand Perfected High-Early-Strength Portland Cement.

*Reg. U. S. Pat. Off.

INTERNATIONAL CEMENT CORPORATION

342 Madison Avenue, New York

A PERFECTED HIGH-EARLY-STRENGTH "INCOR" PORTLAND CEMENT

INTERNATIONAL SYSTEM LONE STAR CEMENT

SUBSIDIARIES

LONE STAR CEMENT COMPANY ALABAMA
Birmingham, Alabama

LONE STAR CEMENT CO. INDIANA, Inc.
Indianapolis, Indiana

THE CUBAN PORTLAND CEMENT CORP.
Havana, Cuba

LONE STAR CEMENT CO. PENNSYLVANIA
Philadelphia, Pennsylvania

THE LONE STAR CEMENT CO. (KANSAS)
Kansas City

LONE STAR CEMENT CO. VIRGINIA, Inc.
Norfolk, Virginia

LONE STAR CEMENT CO. NEW YORK, Inc.
Albany, New York

LONE STAR CEMENT CO. LOUISIANA
New Orleans, Louisiana

ARGENTINE PORTLAND CEMENT CO.
Buenos Aires, Argentina

LONE STAR CEMENT COMPANY TEXAS
Dallas and Houston, Texas

URUGUAY PORTLAND CEMENT COMPANY
Montevideo, Uruguay

One of the world's largest cement producers—13 mills . . . total annual capacity 21,000,000 bbls.

SERVICE EXCHANGE
For
Manufacturers or Distributors

Editor's Note.—From time to time we receive letters from distributors wishing to be put in touch with manufacturers of certain lines of equipment, or from manufacturers seeking representatives for their products. Items of this kind will be published and names and addesses furnished interested persons upon request.

New Lines Wanted

Equipment distributor in Pacific Northwest desires line of road building equipment, structural building equipment, dump bodies and truck hoists.

Distributors of contractors' and builders' machinery and equipment are seeking line of road forms, road finishers, batcher plants, clamshell buckets and drag line buckets, for northern California terirtory. Now stocking equipment for several well known machinery manufacturers.

Manufacturers' agents representing well known lines of water works equipment desire to secure line of pipe pushers and other similar equipment for California and western Nevada territory.

Road machinery distributor would like to secure exclusive sales rights for state of Mississippi for line of automatic or self-loading wheeled scraper.

A Michigan distributor, with many years' experience, representing at this time prominent manufacturers of pumping machinery, offers the services of an established representative to manufacturers needing increased facilities in this region.

Manufacturers' representatives located in New York would like to add line of heavy contractors' equipment of established reputation, other than the lines now handled by them. They would like exclusive sales rights for such equipment.

Canadian distributor of equipment for water softening, filtration, sewage purification and pumping is interested in securing exclusive sales rights for kindred equipment in the Dominion.

Equipment distributor located in Michigan desires to add two or three good lines to serve territory in southeastern part of state.

Wanted for Buffalo, Niagara Frontier and Western New York territory a good power and heating boiler account.

Distributor of building specialties covering a territory of 100 mile radius from Chicago is equipped to represent additional lines.

Machinery distributor established in Porto Rico and Santo Domingo would be pleased to make arrangements to take on new lines in these territories.

Machinery company in the east is interested in representing established lines of road machinery, with the exception of graders.

Distributor thoroughly familiar with bituminous materials and equipment for handling, wishes to add to present lines. Covers Wisconsin and Illinois territory.

Representatives Wanted

Manufacturer of truck, adapted to many uses, has attractive territory open in Missouri, Kentucky, Kansas, Nebraska and several southern states.

Manufacturer of hoisting machinery and air compressors has open territory in New York and New England states for aggressive distributor.

Manufacturer of excavating equipment desires to build up distribution organization throughout the country.

Manufacturer of non-clogging sewage pumps, both horizontal and vertical, as well as water works pumps suitable for municipalities of 50,000 or 60,000 people, is interested in securing additional sales representation.

Manufacturer of two-cycle oil and gas engines, in sizes from 30 to 125 hp., adaptable for water works and many industrial purposes, wishes to establish points of distribution throughout the country.

Well established manufacturers' representatives wanted to handle sand and gravel pumps and equipment, in key cities, by successful manufacturer of high grade dredging pumps and hydraulic dredging equipment. Give character of equipment now being handled and territory covered.

Manufacturer of patented luminous highway danger signs and signals is interested in securing aggressive representation in various parts of this country and Canada.

District representatives wanted for sanitary engineering specialty used extensively in the water works, sewage and swimming pool fields.

Distributors wanted for deep-well turbine pumping unit. Product serves small industrial plants, private estates and farmers.

Manufacturer of water works brass goods would like to make proposition to manufacturers' representatives calling on water works' trade.

Attractive territory available for experienced men to handle contractors' labor-saving equipment by old established company. Equipment backed by national advertising.

New York corporation wishes to establish agencies throughout the country, prefer men specializing in heating and ventilating equipment.

A manufacturer of paving expansion joints is looking for distributors for northern California territory.

Manufacturer of metal lath, corner beads, channels and reinforcing mesh desires to secure distributors for products in the southwest and middlewest.

Manufacturer of threadless pipe couplings and tees, with rapidly growing business, is seeking additional representatives.

Manufacturer of metal tie and spacer wishes to establish distributing points throughout the country.

Manufacturer of mechanical spreaders for cover material desires representation by organizations covering entire states. Several desirable states are still open. Number of inquiries now on hand for spreaders require immediate follow up.

Manufacturer of automatic dipper trip, adapted to any type shovel (steam, gasoline, diesel, electric, etc.); with rapidly growing business, is seeking additional representatives.

Manufacturer of complete line of construction equipment, mixers, saw rigs, plaster and mortar mixers and pumps has an open territory in the state of Maine and is looking for an aggressive distributor to represent him there.

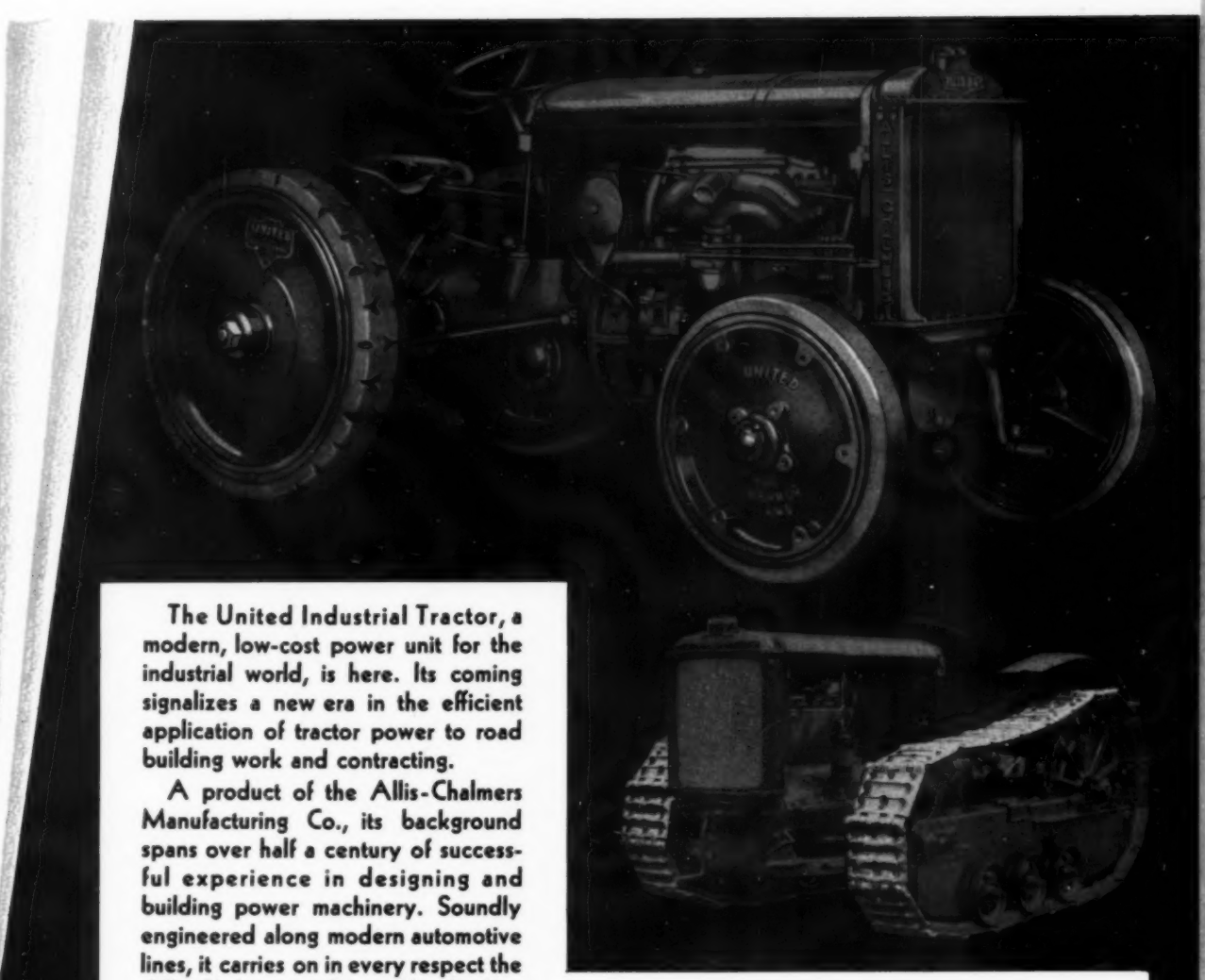
Manufacturer of rotary pump, especially designed for road construction work, has proposition for reliable distribution houses.

Good side-line offered to manufacturers' representatives covering municipalities and public institutions.

Long established and well-known manufacturer of industrial locomotives wishes to make contacts with qualified distributors. Locomotive line includes steam, gasoline, gas-electric and oil-electric. Supported by national trade journal advertising.

Now ready—

the UNITED Industrial Tractor



The United Industrial Tractor, a modern, low-cost power unit for the industrial world, is here. Its coming signalizes a new era in the efficient application of tractor power to road building work and contracting.

A product of the Allis-Chalmers Manufacturing Co., its background spans over half a century of successful experience in designing and building power machinery. Soundly engineered along modern automotive lines, it carries on in every respect the Allis-Chalmers tradition of leadership.

In the United Tractor its builders have taken into account the needs of industry for a powerful and flexible unit adapted to the widest possible range of use. The result is an industrial tractor that in either wheel or crawler type readily accommodates operating equipment and provides efficient low-cost power on all jobs.

United Tractors and Equipment are sold and serviced by authorized United distributors and dealers in the United States and Canada. Investigate the United Line before you buy! Further information on request.

UNITED TRACTOR & EQUIPMENT CORP.

612 NO. MICHIGAN AVE. CHICAGO, ILLINOIS.

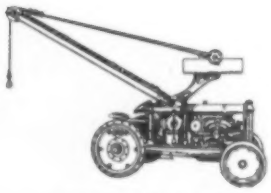
UNITED
TRACTORS & EQUIPMENT

MANUFACTURING MEMBERS

ALLIS-CHALMERS MFG. CO.
BROOKVILLE LOCOMOTIVE CO.
DETROIT HARVESTER CO.
DORSEY BROTHERS
MAINE STEEL PRODUCTS CO.
MUSKOGEE IRON WORKS, INC.
NORTHWESTERN MFG. CO.
PERRY COMPANY
THE HUGHES-KEENAN CO.
TRACKSON COMPANY
UNIVERSAL POWER SHOVEL CO.
WEHR COMPANY

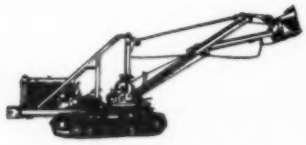
See the UNITED Line at the Atlantic City Road Show—January 13-18

UNITED OPERATING EQUIPMENT
Specially Built for the
UNITED INDUSTRIAL TRACTOR

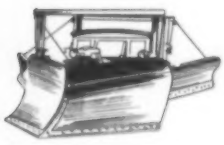


United Full Swing Crane
Built by
The Hughes-Keenan Co.

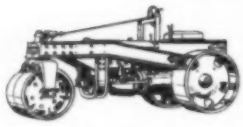
United Center Control Grader
Built by
Wehr Company



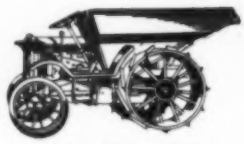
United Power Shovel
Built by
Universal Power Shovel Co.



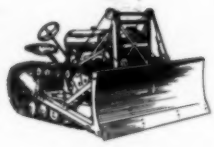
United Snow Plow
Built by
Maine Steel Products Co.



United Roller
Built by
Wehr Company



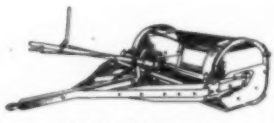
United Iron Mule
Built by
The Hughes-Keenan Co.



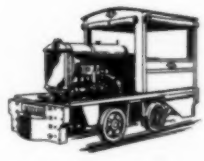
United Bulldozer
Built by
Trackson Company

United Street Sweeper
Built by
Detroit Harvester Co.

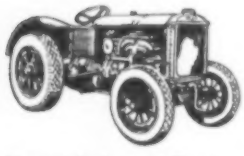
United Skidder
Built by
Dorsey Brothers



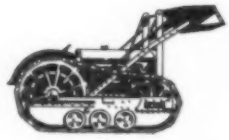
United Scraper
Built by
Perry Company



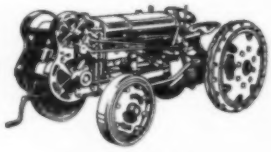
United Locomotive
Built by
Brookville Locomotive Co.



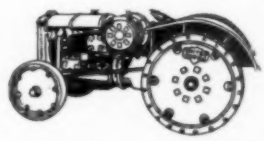
United Industrial Tractor
With Pneumatic Tires
Wheels Manufactured by
French & Hecht



United Front End Shovel
Built by
Trackson Company



United Hoist
Built by
Muskogee Iron Works, Inc.



United Arc Welder
Built by
Northwestern Mfg. Company

For use with this revolutionary tractor, there is a complete line of operating equipment built especially for the United Tractor.

Each unit is an outstanding achievement of a specialized builder of road and contracting equipment. Masterful in performance, low in first cost, economical to operate and maintain, United Tractors and Equipment are Champions of every job!

UNITED TRACTOR & EQUIPMENT CORP.

612 NO. MICHIGAN AVE. CHICAGO, ILLINOIS.

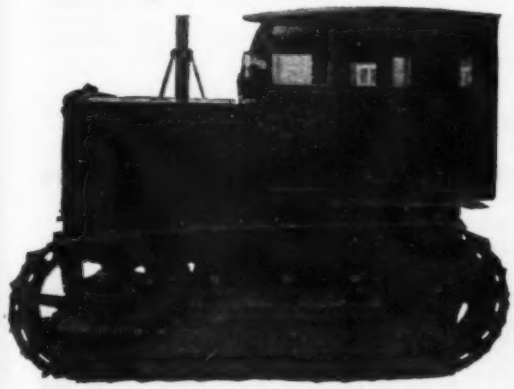
See the UNITED Line at the Atlantic City Road Show—January 13-18

Printed in U.S.A.

"No trouble to keep this road open now!"

"WITH this equipment our roads are always open—the Bates 'Steel Mule' puts the plow thru the worst drifts and we have SNOW in this country. . . ."

Keep your roads open with a Bates "Steel Mule"—They have unusual *Traction* and plenty of reserve power to operate under severe weather conditions.



THE BATES SNOW SPECIAL

Complete protection is provided by an enclosed cab with glass windshield and windows. Equipment consisting of electric starter, electric generator and lights, oil gauge, comfortable seat and controls makes maximum efficiency for every snow and winter operation.

FOOTE BROS. PRODUCTS

Established 1859

MANUFACTURED BY

FOOTE BROS. GEAR & MACHINE CO.

111 N. Canal St. Chicago, Ill.

Write today for your free copy of the Bates tractor book full of valuable tractor information.

BATES Steel Mule

RSB-110

FOOTE BROS. GEAR & MACHINE CO.
111 N. Canal St.
Dept. 103
CHICAGO, ILL.

Please send me copy of the Bates Tractor Book.

Signed_____

Address_____

Members of the 1929 Executive Committee of the Associated Equipment Distributors

Top Row (left to right): A. A. Fuchs, President, Fuchs Equipment Company, Omaha, Nebr.; M. Kaplan, Sales Manager, Superior Supply Company, Chicago; N. Floyd, Jr., Treasurer, Hubbard-Floyd Co., Inc., New York; A. C. Blaisdell, Secretary, The Queen City Supply Co., Cincinnati, Ohio. Center Row: Carl G. Borchert, President, Borchert-Ingersoll Co., St. Paul, Minn.; Edward R. Bacon, President, Edw. R. Bacon Co., San Francisco; M. R. Hunter, President, Hunter Machinery Co., Milwaukee, Wis., and Grand Rapids and Detroit, Mich.; Dan R. Brown, Secretary, Brown-Bevis Co., Los Angeles, Calif.; E. K. Hurst, President, Western Material Co., Sioux Falls, S. D. Bottom Row: William T. Walsh, Secretary, Day & Maddock Co., Cleveland, Ohio; George F. Smith, President, Geo. F. Smith Co., St. Louis; Oscar Bjorge, General Manager, Clyde Equipment Co., Portland, Ore.

• Men Who Have Piloted A. E. D. Through 1929

As 1929 is drawing to a close, Distributor News takes pleasure in presenting a picture of the men who have so successfully carried on the organization work for the Associated Equipment Distributors. The fact that these officials all hold executive positions in the strong equipment companies with which they are connected is a testimony to the type of management that has been given during the past year to the affairs of the Equipment Association.

Mr. Mark Kaplan, Sales Manager for the Superior Supply Company of Chicago, who is publicity spokesman for the A. E. D. states that the association was formed about seven years ago to promote a closer affiliation, better understanding and create a strong "all pull together" spirit for the men engaged in the same line of endeavor. Mr. Kaplan says it is neither the intention nor the desire of the organization to direct its members against any manufacturers, or group of them, or to coerce or use unfair tactics against non-members of the association.

Starting with just a small group of factory distributors at the time the association was formed, the membership now lists among its hundred and twenty-five members many of the leading distributors of construction equipment throughout the country.

During the year it has been the privilege of Distributor News to present individual stories and pictures of several of the companies represented in this group, and now presents them as an official committee through the courtesy of Mr. Kaplan.

C. O. Bartlett & Snow Company of Cleveland, Ohio, announces that Mr. Lloyd R. Wilson, formerly with the Lakewood Engineering Company, is now associated with their organization as manager of sales of Bartlett-Snow truck bodies for transporting ready mixed concrete.

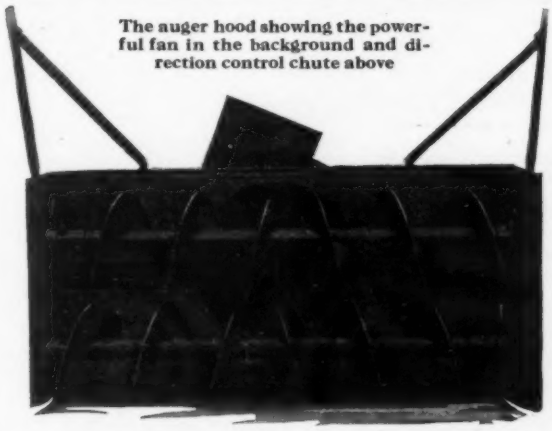
South American Distributors Visited by American Bosch Executive

Mr. Herbert E. Fenner, General Service Manager of the American Bosch Magneto Corporation at Springfield, Mass., sailed from New York recently to make an extended tour of inspection of all the principal cities, and many smaller centers, in the countries of South America.

One of Mr. Fenner's principal duties will be to call upon the branch houses and distributors of those American manufacturers who use American Bosch precision electrical equipment as standard equipment on automotive products of their manufacturer. He will also visit official American Bosch service stations situated throughout the South American continent to make a first hand study of methods and offer advice and suggestions.

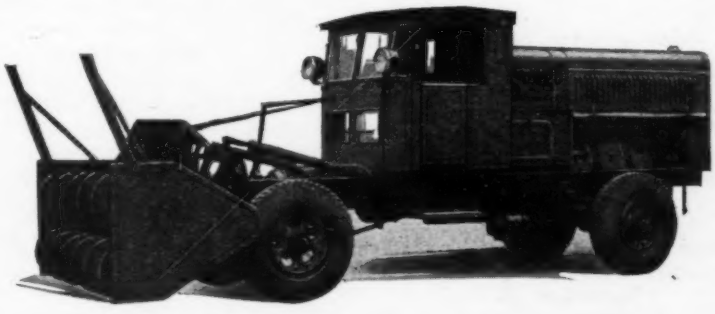
Please mention ROADS AND STREETS—it helps.

Snow Removal with SNOGO
The BANKS
must be removed—if not, this happens



The auger hood showing the powerful fan in the background and direction control chute above

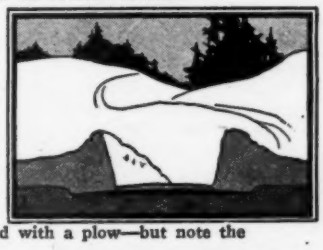
SNOGO is a *complete snow removing unit*—it is *not* an attachment. This in substance means that the entire mechanism is in *proper balance*—one unit with another. *Ample power* for the principle of operation. The fan working in unison with the augers never comes in direct contact with the banks of snow. This permits the fan to develop unusual force. SNOGO will throw the snow *100 feet in either direction*. SNOGO is an all purpose snow remover, as shown below it is used for *highways* and *airports*, and for city work a loading hood is attached which converts it into a very *efficient city machine*. The working principles and features of SNOGO are numerous. We urge you to send for a copy of the SNOGO catalog which tells the complete story.



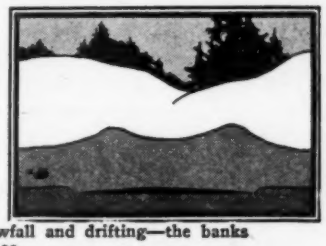
Send for a Copy of the Complete Catalog

for **HIGHWAYS**
CITIES
AIRPORTS

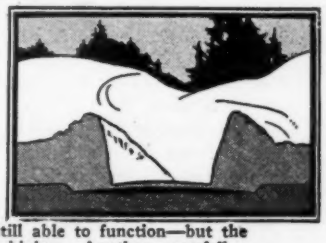
Here is a road after an 18 inch snowfall—



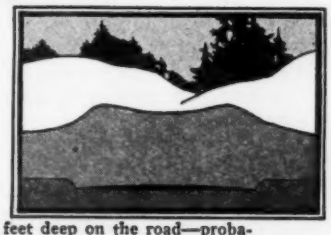
. . . . easily opened with a plow—but note the banks.



Another light snowfall and drifting—the banks act like a snow fence.



Again the plow—still able to function—but the banks are getting higher. Another snowfall—or a little wind, and—



BLOCKED—Six feet deep on the road—probably only two feet in the surrounding fields. This is the wrong method—it is not snow removal! Prevent the above condition by removing the banks—FOLLOW YOUR SPEED PLOWS WITH SNOGO.

Klauer Manufacturing Co.

Dubuque, Iowa

Fruehauf Trailer to Control Warner Co.

Through Mr. Harvey C. Fruehauf, President, the Fruehauf Trailer Company, of Detroit, announces acquisition of the control of the Warner Manufacturing Company of Beloit, Wis. The Warner Company is one of the oldest Trailer manufacturers in the country. It is well established in the hauling field and maintains distributors in more than twenty of the principal cities of this country.

The Warner Manufacturing Company will continue to operate as an independent unit with the same management and sales personnel which handled the company prior to its purchase by the Fruehauf Trailer Company.

Headquarters of the Warner Company will be moved to Detroit at once and all administration and production activities will be carried on there after November 15th of this year, announcement states.

This step marks the amalgamation of two of the oldest trailer manufacturing concerns in the United States and substantial benefits are anticipated for both units. As a result of this merger the Fruehauf Company is placed in a very strong position so far as its patent situation is concerned according to announcement. Further, it is felt that trailer users will realize substantial benefit from this pooling of resources, equipment and executive experience.

H. H. Curtice Heads AC Spark Plug Company

At a recent meeting of the Board of Directors of the AC Spark Plug Company of Flint, Mich., Harlow H. Curtice was elected president and general manager to succeed Basil W. deGuichard, whose resignation was due to ill health.

Just past his twentieth birthday and fresh from Ferris Institute, where he completed a commercial course, back in 1914, Mr. Curtice obtained his first position in the accounting department of the company to which he has now been elected president. His initiative in instituting improvements resulted in his becoming comptroller when he was twenty-one years old, making him, it is said, the youngest executive in the automotive industry.

In 1923 he was made assistant general manager, in which position he gained prominence in factory operations and management work. In 1927 he was given the title of vice-president. Through his management of the affairs of the AC plant, he not only came in contact with every department of his own company, but came in touch with practically all manufacturers in the automotive, aviation and marine industries.

Mr. Curtice's election to the presidency of his company at the age of 36 years places him in the position of one of the youngest major chief executives in the automotive industry. He was born at Eaton Rapids, August 15, 1893, and graduated from the high school before entering Ferris Institute.

No Let-Down In Gardner-Denver Production

According to announcement increased production has been started in the new plant at Quincy, Ill., of the Gardner-Denver Company to take care of unfilled orders which have been piling up.

Gardner-Denver Company are makers of slush and mud pumps, rock drills, air compressors, high pressure drill steel forges and drill sharpeners. In addition to the Quincy plant, factories are located in Denver and LaGrange, Mo.

Young Radiator Announces Second Issue of Employee Insurance

Through the cooperation of the Metropolitan Life Insurance Company, the Young Radiator Company of Racine, Wis., announces the issuance of its second group of insurance policies to 158 employees.

The plan under which the policies were issued was adopted by the officials of the Young Company about a year ago, when the first insurance was taken out, and is offered to both their factory and office worker. Many of the employees who will profit by this arrangement have been associated with the Young interests for a long time.

The Young Radiator Company manufactures heating units, cooling and radiators. Mr. F. M. Young is president of the company.

Robert Bosch Establishes Detroit Office

Robert Bosch Magneto Company, Inc., announces the establishment of a sales office in the General motors building, Detroit, Mich., for the convenience of its manufacturer and trade customers in Detroit and vicinity.

This office will be in charge of Mr. Carl Behn, Jr., Manufacturers Sales Division, and of Mr. D. J. Wilber, Trade Sales Division. Mr. Behn has for 6 years past been associated with the Chicago branch of the Robert Bosch organization as Sales Engineer. Mr. Wilber has been District Representative, Trade Sales Division of this company covering Detroit and vicinity for the past year.

American Asphalt Paint Co. Buys Another Factory Located at Kankakee, Ill.

A new building, containing approximately 100,000 feet of floor space, all of which is available for manufacture, has been purchased by the American Asphalt Paint Company of Chicago for factory purposes. The company's complete line of asphaltic products will be manufactured at the Kankakee plant. One of the officials, speaking for the company, states that the new acquisition will not in any way affect the Lincoln, New Jersey plant which will continue to run at capacity production.

The plant at Kankakee will be put in operation as soon as the new equipment needed can be installed. The products of the company are handled through distributors in this country and in foreign lands.

C. P. Clampitt to Represent Milburn Company in Chicago

Announcement has been made by the Alexander Milburn Company that Mr. Charles P. Clampitt has been placed in charge of their Chicago office located at 220 South State St. Because of Mr. Clampitt's many years experience in the industry and his knowledge of the Chicago territory the Milburn Company believe they have strengthened their sales and engineering service.

A large and varied stock of Milburn products is promised for the Chicago office which will assure prompt delivery service.

False Rumor

The following statement has been received from the Barnes Manufacturing Company, makers of portable pumping units.

"It has been rumored that the Barnes Manufacturing Company, Mansfield, O., and the Jaeger Machine Company, Columbus, have merged. There is no foundation for this report. It is true that Barnes will manufacture certain pumps for Jaeger, to be known as Jaeger-Barnes Pumps. There is no interlocking directorate, not is any planned. Barnes distributors will continue as heretofore."

American Cable Company's Chicago Office Moves to New Quarters

The Chicago headquarters of the American Cable Company, handling sales and service on Tru-Lay wire rope and Tru-Loc fittings in the Chicago region, have been moved to the recently completed Chicago Daily News Building. The former address was 160 N. La Salle street; the new is Room 1765, 400 West Madison street, Chicago, Ill.

Announcement

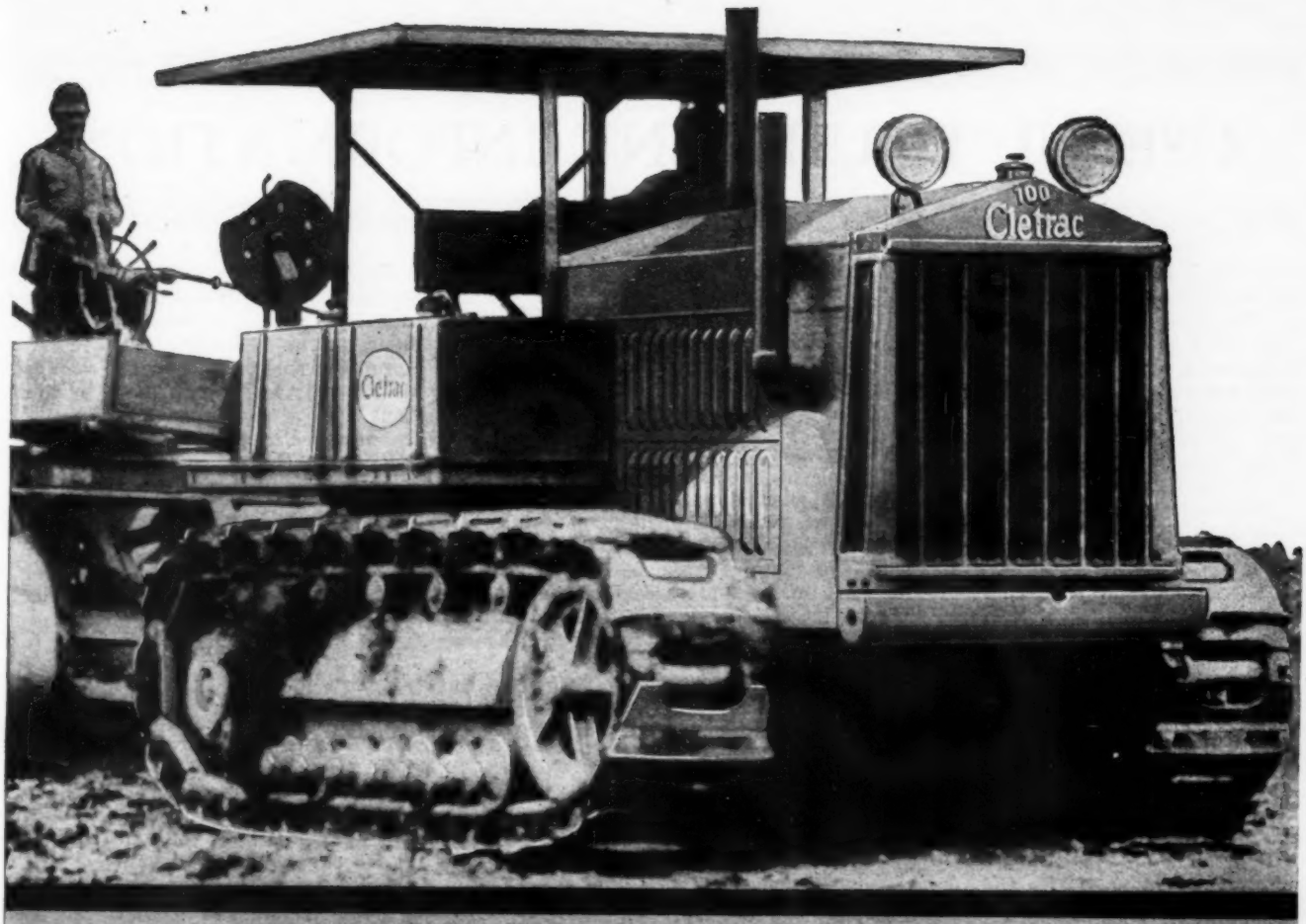
The Independent Pneumatic Tool Company, 600 W. Jackson Boulevard, Chicago, announces the following organization changes:

Mr. Joseph P. Fletcher, manager of the company's Buffalo office, has been appointed manager of the Philadelphia office to succeed the late Mr. A. L. Schuhl.

Mr. W. O. Becker, who has been working out of the Toronto office, has been named as manager of the Buffalo office to succeed Mr. Fletcher.

Sales Engineer

Old established manufacturer of road construction equipment (crushers, elevators, conveyors, etc.), wishes representative for New England territory. Salary, commission and expenses. Must have had five years' experience and proven sales and engineering ability. Address Box 121, Watertown, Mass.



Cletrac

CRAWLER TRACTORS

Look them over at the

ROAD SHOW

ATLANTIC CITY

THE CLEVELAND TRACTOR COMPANY, CLEVELAND, OHIO

Week of January 13th 1930

USEFUL EQUIPMENT INFORMATION

By writing the manufacturers named and mentioning this magazine, copies of the catalogs listed below will be sent you without obligation.

Keeping Airports Clear in Winter.—An unusual 20-page book, its third piece of literature devoted to airports, has just been issued by the Caterpillar Tractor Co. It tells the story of winter mail and passenger carrying on schedule where Caterpillar tractors are available at airports for snow removal. Write for a copy to San Leandro, Calif., or Peoria, Ill.

Westinghouse Airport Lighting.—A new publication has just been released by the Westinghouse Electric & Manufacturing Co. on airport lighting. This booklet, No. S. P. 1854, shows the part Westinghouse is playing in the advancement of aviation by furnishing adequate lighting equipment for the night illumination of airports. Contained in the publication are the lighting requirements of the U. S. Department of Commerce, including the candlepower for beacons, wattage for boundary lights, obstruction light requirements and the location and intensity of illumination of floodlights and ceiling projectors. The Westinghouse general plan for airport illumination is given with a diagram to illustrate, along with a description of the lighting installation at the Newark metropolitan airport, and detailed descriptions of Westinghouse floodlights, marker and hangar lights. The whole booklet is profusely illustrated with installation photographs showing day and night views of lighted airports and diagrams of the layout of landing fields.

Road Grader.—The Western No. 32 International road grader, a one-man patrol grader formed by combining a Western No. 32 grader with a McCormick-Deering 10-20 tractor, is discussed in a recent bulletin of the Austin-Western Road Machinery Co., Chicago, Ill.

Cold Patch Repairs.—A revised edition of "Texaco Cold Patch," a booklet dealing with the repair of roads and streets by the cold patch method, has been issued by the Texas Co., 17 Battery Place, New York, N. Y.

Warco Road Machinery.—The mid-season road machinery catalog of the W. A. Riddell Co., Bucyrus, O., illustrates and describes in detail, and gives brief specifications of, Warco road machinery, including power graders, rollers, wheeled scoops and rear-type crawlers for application to industrial tractors. Copies will be gladly sent upon request.

Snow Fence.—A snow fence designed to prevent over topping by drifts is described in literature issued recently by the Northfield Iron Co., 494 Nico St., Northfield, Minn. It is stated that the fence is so constructed that when set at about a 30 degree angle it shoots the wind down to the ground, piles snow twice the height of the fence, and keeps drifts away from the fence. The fence is made of 6 in. wide 8 ft. 5½ in. long pressed steel boards, with painted steel angle posts, 2 in. x 1½ in. x 6 ft. long. The pressed steel boards for 1,000 ft. of fence make a pile only 26 in. high, 6 in. wide and 101½ in. long. It is stated that two men can drive the posts and lay up 2,000 to 3,000 ft. of fence per day.

Snow Plows.—Sargent all-welded steel snow plows for motor trucks and tractors are described in literature issued recently by the Maine Steel Products Co., South Portland, Me. The operating principles of these plows are illustrated and described and specifications for them are given. Two models of truck plows are shown; one for motor trucks of 3 tons capacity and up, and one for motor trucks of 1½ to 2 tons capacity. For the tractor plows there are six models. The plows are designed particularly to meet the extreme variability of actual snow conditions.

Leaning-Wheel Grader.—The Austin standard 7-ft. leaning-wheel grader is described in a bulletin issued by the Austin-Western Road Machinery Co., 400 N. Michigan Ave., Chicago, Ill. This bulletin is well illustrated. Copies are available for distribution.

Expansion Joint.—The Truscon "air-cushion" expansion joint is fully described in a recent bulletin of the Truscon Steel Co., Youngstown, Ohio. This joint consists essentially of metallic sides forming an air space free for expansion. The air space is closed at the top by a bellows-shaped piece of galvanized copper-bearing steel which prevents dirt working into the joint from the top of the pavement. The bulletin, which lists advantages of this type of joint and gives dimensioned drawings, will be sent to all who are interested upon request.

Road Graders.—Write to Foote Bros. Gear & Machine Co. for Catalog S-100, describing Stockland road graders. Diagrams and photographs illustrate features of the Stockland design. Specifications are given. The manufacturers will be pleased to send you a copy.

Torches, Kettles, Heaters.—"Aeroil" torches, melting furnaces, kettles and tool heaters for pavement work are described in a leaflet issued by the Aeroil Burner Co., Inc., West New York, N. J. This leaflet and other publications will be sent upon application to the manufacturer.

Pavers.—The latest edition of the Foote catalog is an attractive 36-page booklet, describing the 1929 MultiFoote models. The several units of the paver are discussed in detail, with the aid of photographs. Detailed specifications and line drawings are appended. The Foote Co., Nunda, N. Y., will be pleased to furnish a copy.

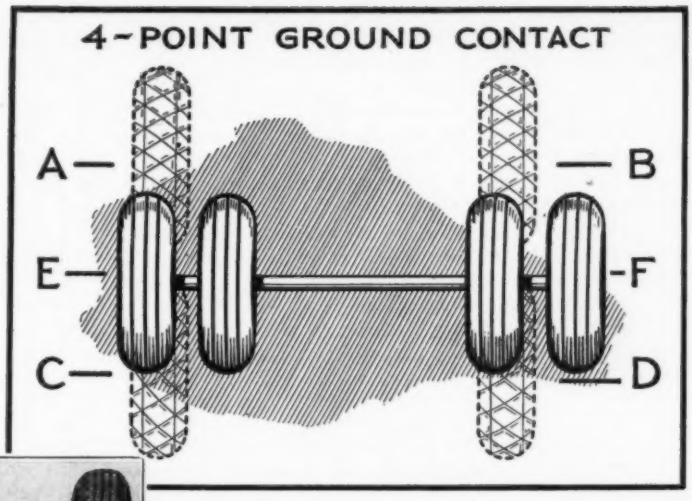
Bid Record Book.—A convenience for contractors is the bid record book issued by the International Combustion Tar & Chemical Corp., 200 Madison Ave., New York, N. Y. Convenient forms for the recording of bids are provided, as well as useful tables for paving contractors. Single copies of the booklet or a small supply will be furnished upon request.

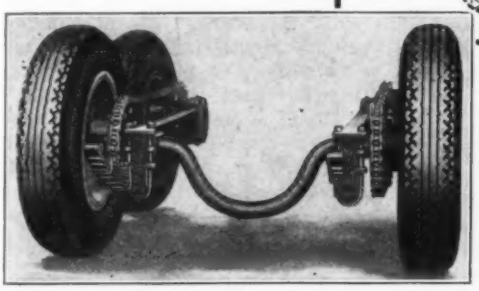
Road Graders.—Two new bulletins, describing the Western No. 22 and No. 55 graders, come from the Austin-Western Road Machinery Co., 400 N. Michigan Ave., Chicago, Ill. The Western No. 22 is a leaning-wheel grader, suitable for use as a patrol grader and for light grading and ditching. The Western No. 55 is a sturdy machine, suitable for maintenance work as well as for road construction. These bulletins should be in your files.

Bates Steel Mule.—Bates "Steel Mule" tractors are described in Catalog B-100, issued by Foote Bros. Gear & Machine Co., Chicago, Ill., who are now manufacturing the Bates machines. This booklet is profusely illustrated, and specifications of the Bates models "30," "40" and "80" are included. Write for a copy.

For Users of Trailers.—A recent bulletin describes the Martin automatic-spring-type fifth wheel, a device for connecting a semi-trailer to a tractor. The fifth wheel is self-aligning and is operated from the driver's seat. The Martin Trailer Co., P. O. Box 508, Westfield, Mass., will be glad to send you this bulletin.

Stump-Pullers and Skidders.—Recent bulletins issued by Dorsey Bros., of Elba, Ala., describe the Dorsey line of stump-pulling and skidding machinery. Fordson and Caterpillar tractor rigs are pictured, and profuse testimonials testifying to the performance of Dorsey land-clearing machinery are presented. The manufacturers will be glad to hear from you.





The diagrams above and at the left clearly demonstrate the difference between the Austin Dual Drive and other so-called "double-traction" drives. The Dual Drive has a driving contact with the ground at four points—A, B, C and D. Tractive effort is applied simultaneously along two distinct lines, AB and CD. Other types of drive, regardless of the number of wheels, lack the tractive efficiency of the Austin Dual Drive because they do not have 4-point ground contact in four separate areas.

4-Point ground contact increases Dual Drive efficiency

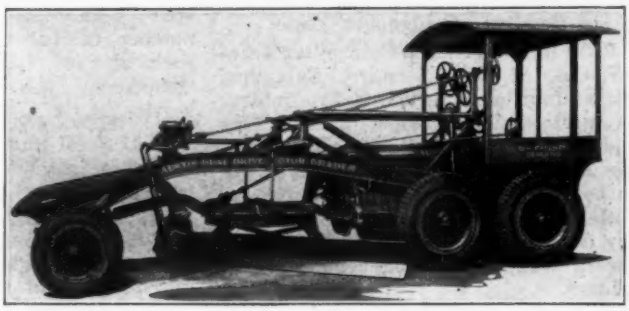
The Austin Dual Drive Motor Grader offers more power—more traction—freedom from skidding or miring and easier handling—*at no increase in operating costs!*

The four great drive wheels provide more and better ground contact, being spread over four distinct areas that are entirely separate from each other.

If one or two wheels run into soft or wet spots there will still be two or three left on hard ground. In this way Austin Dual Drives always afford enough traction to carry the grader through places where two-wheel and so-called "double-traction" drives would stall and have to be dug or towed out. The forward drive wheels press down the softer ground and provide a solid footing for the rear drive wheels following immediately after.

The increased ground contact and side area of the four drive wheels provide greater resistance to side-slipping or skidding. Instead of one rear wheel to serve as the pivotal point of a skid—the Dual Drive opposes a base line several feet long between the points of contact of two drive in tandem.

This distribution of tractive effort over a wider area means surer footing when bad spots are encountered. Because of this, Austin Dual Drive Motor Graders are out on the road more quickly after a storm and earlier in the spring.



State Highway Departments and others have shown a desire for Pneumatic Tires. The Austin Dual Drive Motor Grader is shown above equipped with Pneumatic Tires.

For literature and full information, write The Austin-Western Road Machinery Co., 400 North Michigan Avenue, Chicago, Illinois. Branches in principal cities.

1930 Convention and Road Show—A. R. B. A., Atlantic City, New Jersey—January 13-18

Austin-Western
ROAD MACHINERY

Slackline Cableway Excavators.—"Excavating for Profit," listed as Catalog No. 12, has been issued by Sauerman Bros., Inc., 438 S. Clinton St., Chicago, Ill. Although the title of this catalog is the same as the previous Sauerman slackline cableway excavator catalog, the text and illustrations are new and all the latest improvements in the various parts of the equipment, such as steel masts, roller-bearing sheave blocks, two-speed and three-speed hoists, etc., are dealt with in great detail. Diagrams, photographs and illustrations of specific installations make this catalog actually a text on the use of slackline cableways for excavation purposes. The manufacturers will be glad to send you a copy.

Telsmith Crushers.—Write to the Smith Engineering Works, Milwaukee, Wis., for Bulletin No. 264B, describing Telsmith jaw crushers. It is worthy of note that all Telsmith jaw crushers are protected against breakage by tramp iron by the exclusive Telsmith friction safety device. Telsmith portable rigs are also described.

Chain Data.—An interesting and helpful pamphlet bearing the title "Chain for Cranes, Dredges and Heavy Duty" has just been issued by the American Chain Co., Inc. It contains tables showing the number of links per foot, weights, proof tests and safe working loads of the different sizes of crane and dredge chain and other information which buyers and users of chain will find valuable for their files. Copies may be obtained without charge by addressing a request to American Chain Co., Inc., Bridgeport, Conn.

Road Building.—The Caterpillar Tractor Co., of San Leandro, Cal., has issued four of a series of five folders having to do with the use of Caterpillar and Russel equipment in the maintaining and building of roads. These are rather attractive folders and are replete with illustrations of the machinery described in action. The manufacturers will be glad to send you the folders.

Portable Screening and Loading Plants.—The Pioneer Gravel Equipment Mfg. Co., has just issued an 80 page catalog, covering their complete line of the 11 different sizes of portable screening and loading plants manufactured by them. This catalog is well illustrated. It contains views of installations and blue prints, describing the various setups for the respective plants. It also covers fully the five different sizes of gravel loading plants and the three widths of belt conveyors offered. The construction of the plants, as well as the drag line and conveyors is clearly shown by separate cuts. Copies of the catalog may be had on application to the home office at Minneapolis, Minn., or any of its distributors.

Motor Sweepers.—The Austin motor pick-up sweeper is described in Catalog No. 8, issued by the Austin Manufacturing Co., 400 North Michigan Ave., Chicago, Ill. This is a sprinkler-sweeper with oscillating gutter broom and rear pick-up broom. The catalog contains specifications and detailed drawings, photographs and cross-sections of the sweeper. The manufacturers will be pleased to furnish you with a copy.

Concrete Delivery Body.—The R. C. M. delivery tank for the delivery of wet concrete from a central mixing plant is described in a folder issued by the Portland Concrete Machines Co., 53 W. Jackson Blvd., Chicago. This tank, which is hermetically sealed during delivery, is arranged to rotate while the concrete is being conveyed. Internal vanes tend to promote uniformity throughout the mass of concrete. The tank can be installed on any standard truck chassis. The folder will be sent upon request.

Air Compressors and Exhausters.—The Allen Air Appliance Co., 452 Lexington Ave., New York, N. Y., will be glad to send you their Bulletin No. A-50, describing uses of "Triple-A" air appliances. The booklet is illustrated, and a perusal of it will repay anyone who has a possible job for air.

Air Compressors and Tools.—Write to the Ingersoll-Rand Co., 11 Broadway, New York, N. Y., for the latest bulletin describing Ingersoll-Rand portable air compressors and tools. Machines are available for rock drilling and pavement breaking, trench digging and backfilling, hoisting and hauling, grinding and surfacing, riveting, sheet pile driving, spray painting, tie tamping, etc. A table is included, giving the number of Ingersoll-Rand tools that each size of Ingersoll-Rand portable compressor will operate in general service.

Drill Steel Sharpener.—The Sullivan Machinery Co. has just published a new bulletin on its light model drill steel sharpener, class "C." This bulletin, No. 72-N, contains 16 pages and is fully illustrated with details of the sharpener and pictures of the machine at work. This sharpener is suitable for work on hammer drill bits and shanks for the lighter drills, and is also effective for making pick and chisel point bits for concrete breakers and similar tools. As in all Sullivan sharpeners, the "all-hammer" principle of upsetting and swaging the steel is employed, thus retaining the original quality of the steel and increasing its toughness and resistance to wear. Copies of this new bulletin will be sent upon request to the Sullivan Machinery Co., 400 North Michigan Ave., Chicago.

Rotary Pumps.—The Geo. D. Roper Corp., of Rockford, Ill., has issued a 16-page booklet presenting Trahern rotary pumps for a multitude of uses. Various installations are set forth and valuable data tables are presented, giving dimensions and capacities of the several units. A copy may be secured upon application.

Hood Pneumatic Tires.—The Hood Tire Co. has issued two booklets, "A New Leader Among the Giant Pneumatics" and "How to Get More Mileage and Better Service from Pneumatic Truck Tires." As indicated, the former is the story of the Hood truck tire, whilst the latter contains information and suggestions for truck drivers. The manufacturers will be pleased to send you copies.

Sullivan Concrete and Clay Tools.—Two bulletins, just issued by the Sullivan Machinery Co., Chicago, Ill., describe improved compressed-air concrete breakers and clay spaders. Sullivan type "M-1" spaders, described in Bulletin 87-A, weigh 25½ lb. and may be equipped with several types of handles and throttles. An improved tool retainer is a feature of these diggers. Bulletin 87-B presents Sullivan "K-2" and "K-4" concrete breakers. A special head has been developed to convert these breakers into sheet-pile drivers. The bulletins are 8½x11 in. in size and are printed in two colors.

Cletrac Tractor.—A new broadside issued by the Cleveland Tractor Co., Cleveland, O., features the use of Cletracs for road construction, maintenance and general dirt-moving operations. It is liberally illustrated and shows all the Cletrac models in service.

Locomotive Cranes.—The most recent bulletin of the Thew Shovel Co., Lorain, O., covers the 15 and 20-ton Lorain locomotive cranes, powered by gasoline, electric or diesel motors. This will be found a comprehensive presentation of these models, giving a detailed description, specifications and capacity tables. A copy will be sent upon request.

Locomotives.—The George D. Whitcomb Co., Rochelle, Ill., has recently prepared a little booklet entitled "Locomotives with Internal Combustion Engine Drive." In this booklet they have compared locomotives powered with internal combustion engines to other types of power. They will be glad to send the booklet to anyone who will write for it.

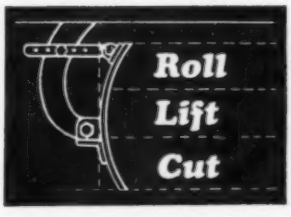
Caterpillar Tractors.—"Public Service and Utilities," "Moving Things," "Maneuverability and Non-Slip Traction," "Mines, Quarries and Clay Plants," "Improving and Maintaining Airports, Cemeteries, Golf Courses, Race Tracks, Resorts, Etc.," "Traction for Manufacturing," "Who Owns Caterpillar Track-Type Tractors in Industry?" and "Caterpillar Tractors in the Oil Industry" are the titles of a set of bulletins recently issued by the Caterpillar Tractor Co., San Leandro, Calif., describing the varied uses of Caterpillar tractors.

Sullivan Pavement Tester.—Bulletin 85-C of the Sullivan Machinery Co., Chicago, Ill., illustrates and describes the improved Sullivan pavement tester, type "2." The standard bit of this tester removes a core 5¾ in. in diameter and cuts a hole about 7 in. across. A pavement 7 in. in thickness has been

Dotted line shows maximum angle of tilt—note safety stops

has it 3 point Suspension?

You bet! and that's not all—



The famous plow principle blade with a cut-lift-roll feature that does the work easily at less cost.

"THE scientifically curved blade plows easily—instead of pushing hard. Note the exceptionally *low center of gravity*—with plenty of clearance. On a slope the weight rests nearer the center of the blade. The frame cannot buckle or bend under the load because it is *straight line construction.*

STOCKLAND ROAD GRADERS

RSS-110

Know Your Grader—Write today for this book

STOCKLAND Road Graders

FOOTE BROS. GEAR & MACHINE CO.
111 N. Canal St.,
Chicago, Ill.
Dept 104

Please send me copy of Stockland Road Grader Book.

Signed_____

Address_____

penetrated in 7 min., it is stated. Copies of this 8-page bulletin may be obtained from the main office of the Sullivan Machinery Co.

Loxite.—"Loxite" is the copyrighted trade name of a recently-perfected liquid-oxygen explosive. The Keith Dunham Co., 110 S. Dearborn St., Chicago, manufacturers of this product, nave issued a descriptive booklet indicating the process of manufacture and presenting instances of the effective use of "Loxite" for primary blasting. If you are a user of explosives, this booklet should be in your possession. A copy is yours upon request.

Moore Speedcrane.—The latest catalog of the Manitowoc Engineering Works, Manitowoc, Wis., describing the Moore "Speedcrane" shovel, dragline and trenchoe, presents a number of advanced features incorporated in this equipment. A copy may be secured by writing to the manufacturers.

High-Early-Strength Cement. — Examples of the saving of time on paving jobs by the use of "Incor" high-early-strength portland cement are cited in a folder recently issued by the International Cement Corp., 342 Madison Ave., New York, N. Y. This corporation is composed of 11 cement companies in the United States, Cuba, and South America, which have a combined output of 20,000,000 barrels of cement annually. Contractors and officials who are interested in minimizing delays caused by construction should write for this bulletin.

Marquette Cement.—"Marquette Super Cement Concrete" is the title of a 24-page booklet recently issued by the Marquette Cement Manufacturing Co., Chicago, Ill. Various jobs in which Marquette cement has been used are illustrated. There is included a brief manual of recommended construction practice, covering the structural use of this manufacturer's product. Write for a copy.

Servicised Products.—Catalog No. 12 of the Servicised Products Corp. has just come from the printer. This book deals with expansion joints in a rather brief but fairly complete manner, and treats exhaustively of other Servicised products of later development. Most important of these are fibrated asphalt planking, industrial flooring, rail filler, highway crossings and protection course for waterproofing. Readers interested in any way in waterproofing protection materials for use in connection with concrete construction for any purpose will find much that is interesting in the new Servicised catalog. Servicised expansion joints are treated completely in Servicised catalog No. 11, which is also available.

"Quikard" Cement.—"Quikard" for speed in concrete construction is the theme of a recent bulletin issued by the Ash Grove Lime & Portland Cement Co., of Kansas City, Mo. This bulletin presents results of laboratory tests and is replete with instances in which concrete employing this high-early-strength cement was carrying its full load within from 24 to 48 hours. Specifications are included. Copies are available for distribution.

One-Bag Mixer.—A folder from the Construction Machinery Co., Waterloo, Iowa, presents the improved Marsh-Capron "Master" 7-S mixer. The manufacturer describes this mixer as "the last word in mixer construction, performance and speed." There are specifications and drawings. Copies of the folder are available.

Crane, Shovel and Dragline.—Catalog No. 629 of the Byers Machine Co., Ravenna, Ohio, announces a ¾-yd. crane, shovel and dragline. This machine is new in model but old in design, the same design being carried through all models from the ½-yd. "Bull Dog" model to the 1¼-yd. "Master." The Byers independent cable crowd and 36 other features are described. Tables and diagrams giving ranges, clearances and capacities are included. The catalog will be sent upon request.

Air Compressors.—Bulletin No. 147 of the Pennsylvania Pump & Compressor Co., Easton, Pa., describing Pennsylvania single-stage air compressors, is now ready for distribution. This bulletin contains an interesting cross-sectional view of a Pennsylvania class 3-A compressor, together with a description and illustrations of Pennsylvania methods of compressor regulation. Tables giving sizes, capacities and ratings are included. Copies are available.

Spreaders.—Bulletin No. 101 of the Stolle Road Equipment Co., describes the Stolle "Senior" spreader for road material. This spreader may be attached to any dump truck and will operate equally well irrespective of the direction in which the truck travels. The folder contains photographs of the spreader in action and instances of the savings effected through its use. Write to the Stolle Road Equipment Co., Inc., 321 South Grand Blvd., St. Louis, Mo., for a copy.

Pavement Reinforcing. — The Concrete Steel Co., 42 Broadway, New York, N. Y., has issued a 32-page booklet, "Economical Concrete Road Reinforcement." Havemeyer barmats; metal chairs, ties and spacers; Hoosier asphalt expansion joints; wire mesh and curb bars are described in detail with the aid of drawings and photographs. Instructions for installing Havemeyer products are given. Copies are available to those interested.

Pavers.—A new, illustrated, 34-page catalog has just been published by the Foote Co., Inc., of Nunda, N. Y., manufacturers of MultiFoote pavers, describing their machines for the 1929 season. The new catalog is unusually complete in the number of illustrations and in construction data on the machines. Practically every part of the machine is illustrated with cutaway views making the construction and operation of all parts easily understood. The Foote automatic water control, which can be set to measure any desired quantity of water and is largely automatic in its operation, is explained in detail. Several pages of detailed specifications covering both the 27-E and 13-E pavers are given. A copy is yours for the asking.

Leaning-Wheel Grader.—Bulletin 1077 of the Austin-Western Road Machinery Co., 400 N. Michigan Ave., Chicago, is a companion piece to an earlier bulletin, describing the Austin 12-ft. leaning-wheel grader. Bulletin 1077 describes the Austin 8-ft. leaning-wheel grader by means of illustrations and text. Specifications are included. This grader is described as an ideal all-around model for public officials and contractors, and this bulletin deserves a place in the files of all who come under either of these classifications.

Haiss Excavator.—The new Haiss excavator is described in Bulletin 629 of the George Haiss Manufacturing Co., Inc., New York, N. Y. The Haiss excavator will dig and load any earth, clay or natural soil that can be picked loose by a man with a hand pick and then shoveled. It is stated that, on an average 15-in. cut, this machine will excavate and load from 1¾ to 2 cu. yd. per minute. The new bulletin gives a selection of typical jobs performed by the Haiss machine. A copy will be furnished upon request.

Headley Grade Crossings.—Headley grade crossings and platforms for steam and electric railroads are described in a booklet issued by the Headley Good Roads Co., Franklin Trust Building, Philadelphia, Pa. "Headley No. 1" is an emulsified asphalt cement. Used to bond crushed stone or other suitable aggregate, it makes a safe, economical and durable crossing or platform. The booklet gives directions for mixing and applying. The manufacturers will be pleased to furnish you with a copy.

Core Drills.—Circular No. 29-B, issued by Sprague & Henwood, Inc., 221 West Olive St., Scranton, Pa., describes core drills and supplies manufactured by this firm. Of particular interest is a pavement core drill, arranged for mounting on a motor truck, making it convenient for the use of highway engineers. A copy of the circular will be sent upon request.

Good Roads Equipment. — Recent publications of the Good Roads Machinery Co. include booklets describing the Good Roads "motograder," the Good Roads senior roller, the Good Roads "autograder" and the Good Roads cold application oil distributors. These booklets contain detailed descriptions and specifications, along with photographs of the equipment in action. Write to the manufacturers for copies.

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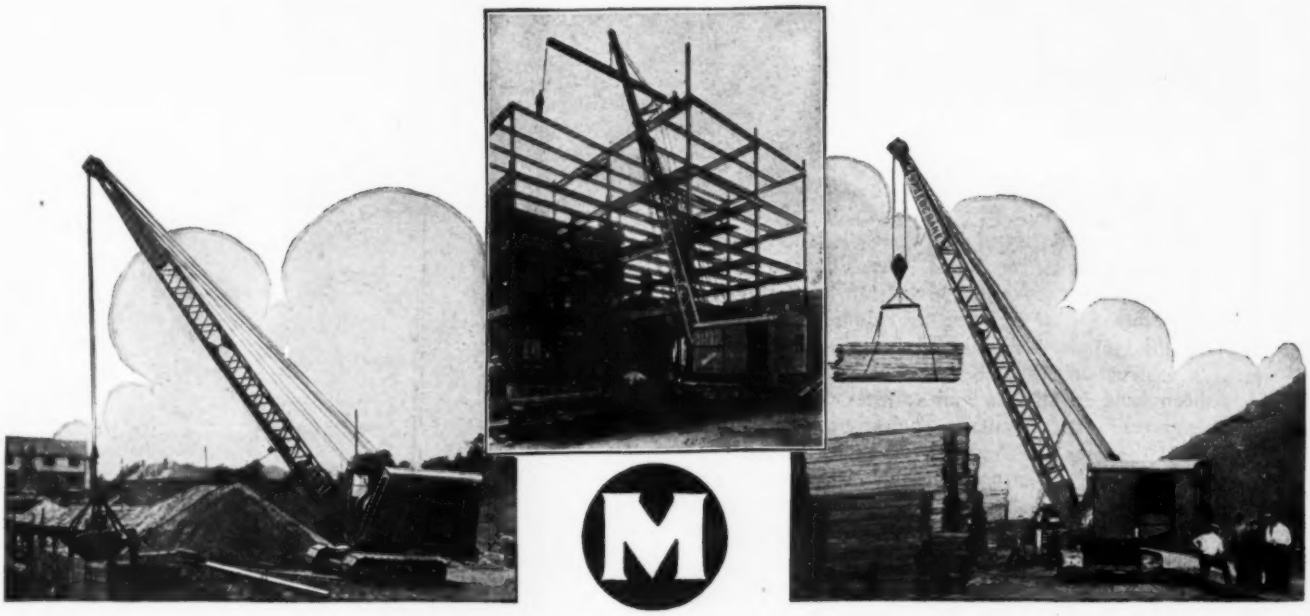

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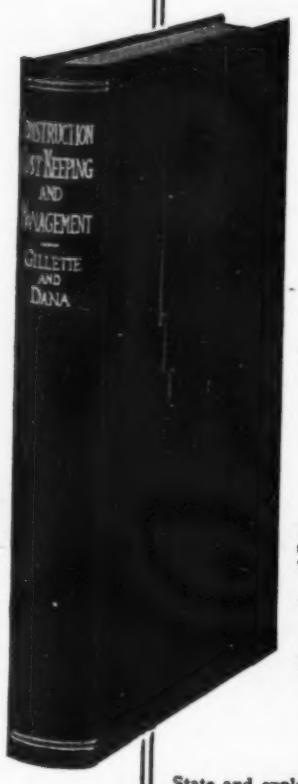

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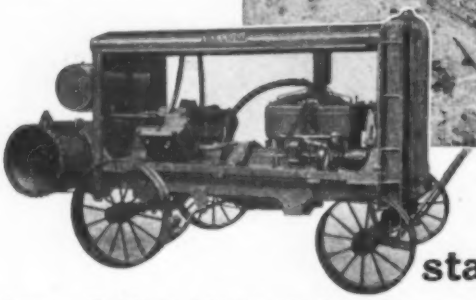
Two of the 23 Sullivan Vibrationless Compressors at work in Snoqualmie Pass. Below, Sullivan 310-ft. Vibrationless Compressor, on steel wheels.



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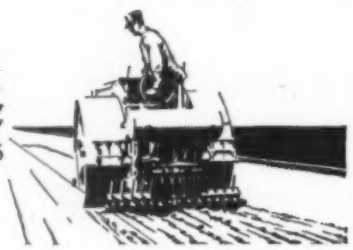

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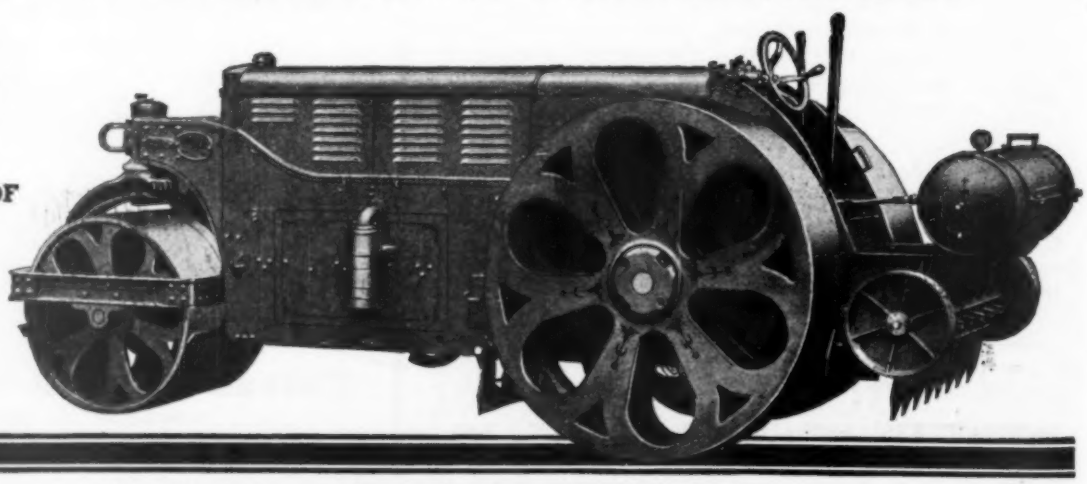

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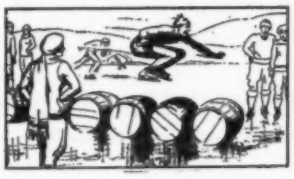

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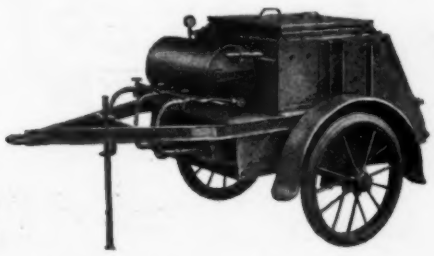

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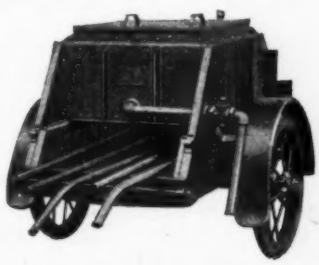

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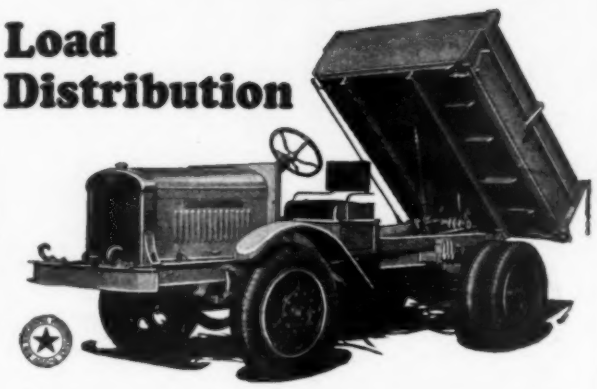

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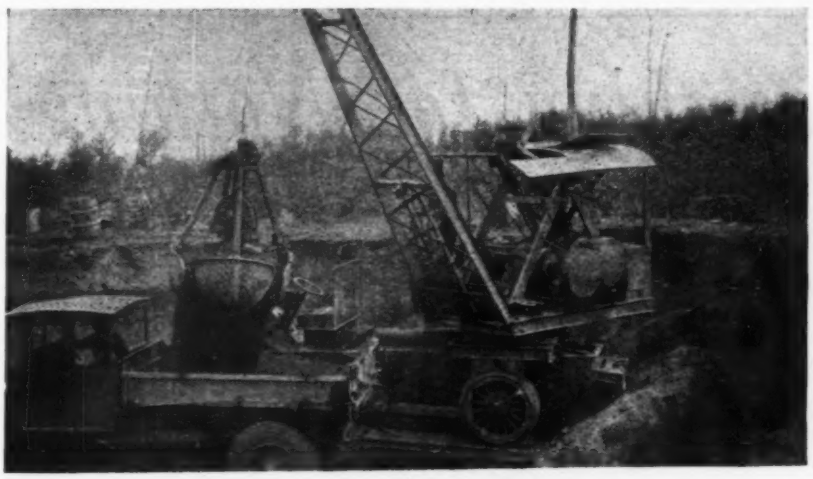

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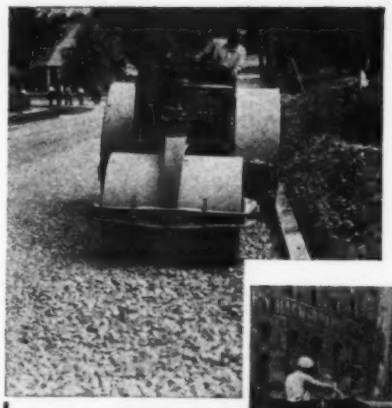

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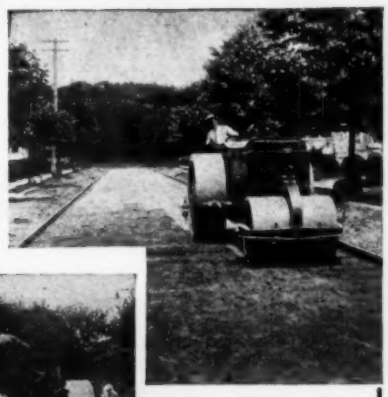

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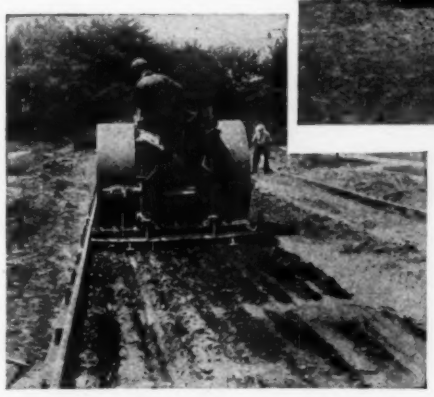

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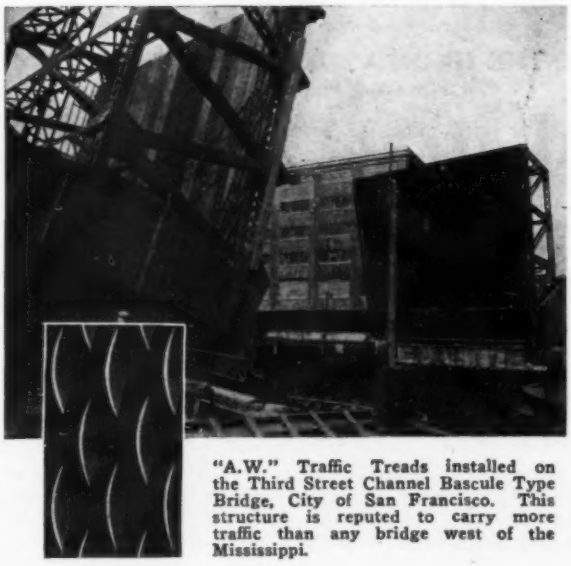

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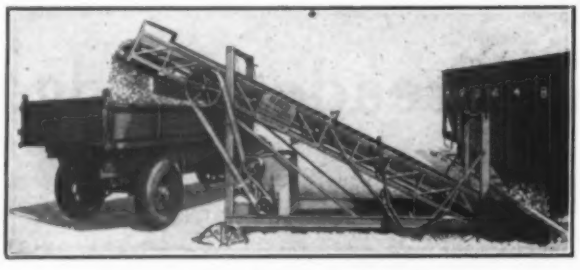

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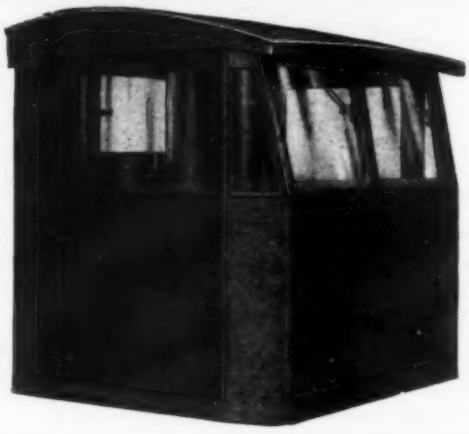

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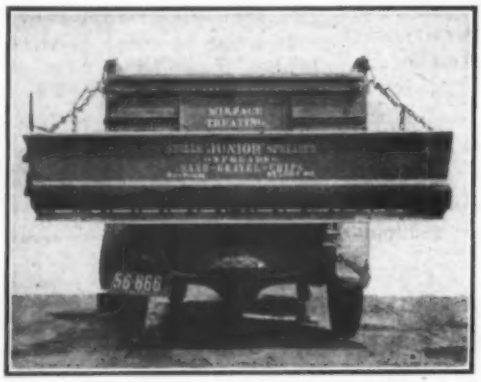

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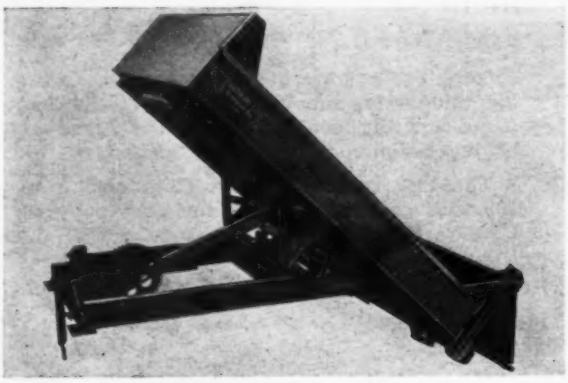

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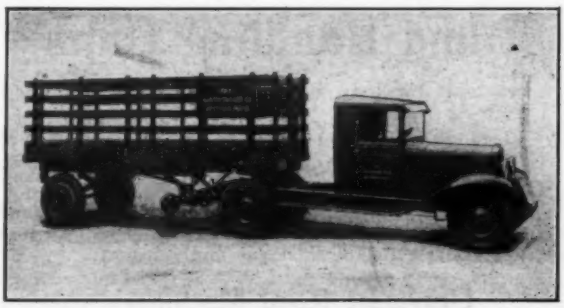

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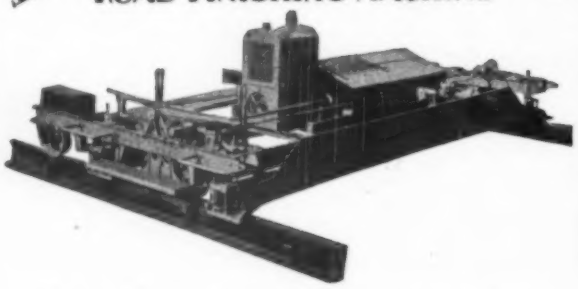

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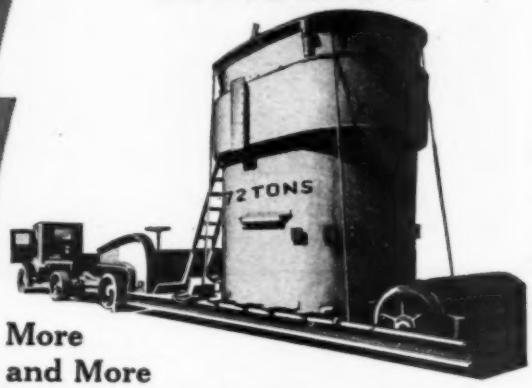

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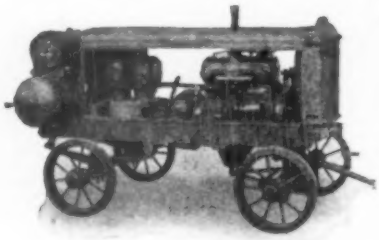

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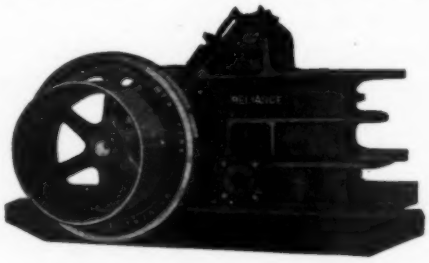

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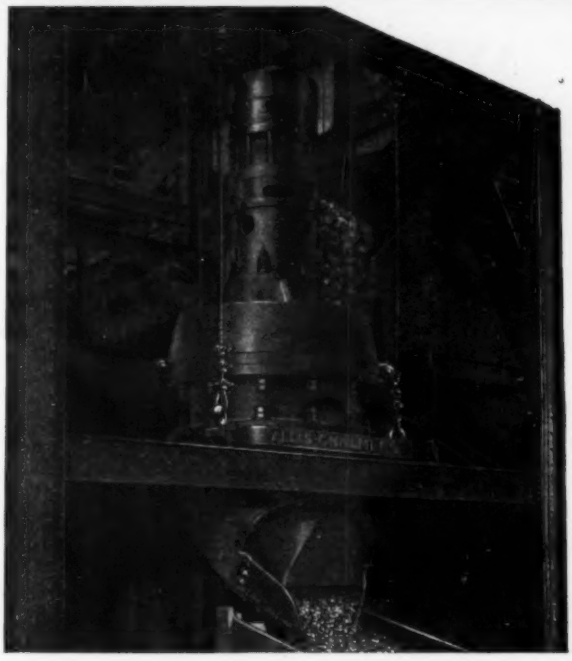

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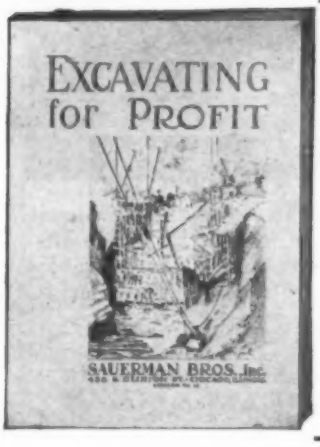

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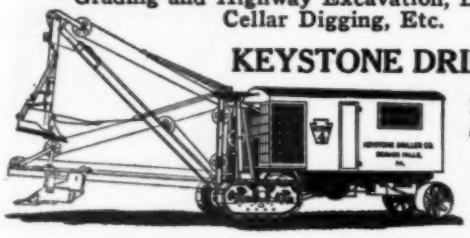

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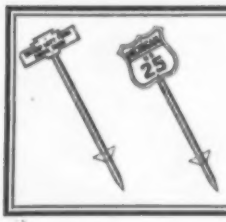

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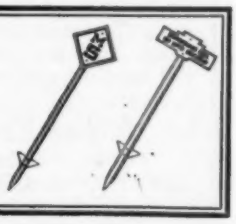

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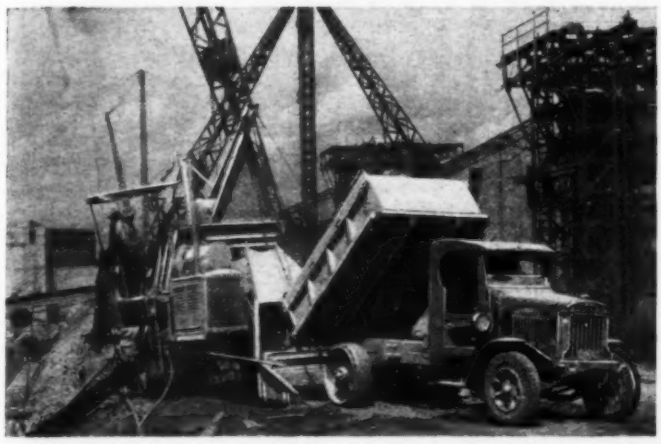

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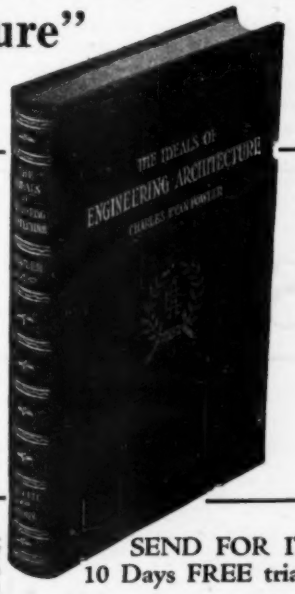

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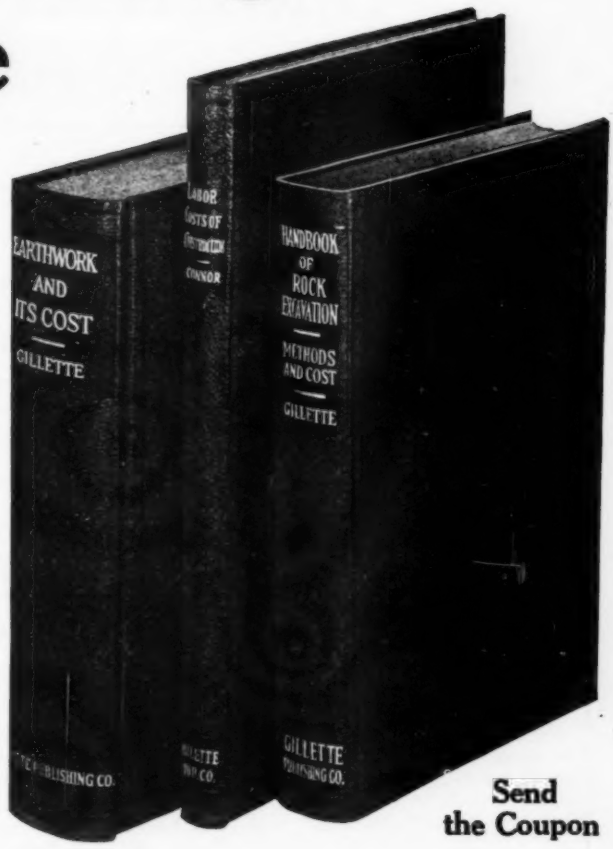

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A Trip with our Editor

Levee banks make steep going!

Cutting of river bank at end of revetment.

Cypress stumps on right of way. Impassable in car.

Revetment sinking plant.

First tower machine built by the government.

Down the Mississippi wherever levee work is going on, there went the editor. From sun-up to sun-down, driving his car thru places where only tractors should go. Across soft borrow pits; thru cotton fields and sometimes tipped sideways on the slopes of levees, performing stunts which no self-respecting city car should be expected to attempt, on and on he went determined to see as much as possible of work accomplished, and watch government and contract outfits "on the job."

The new program which the government has undertaken involves about $300,000,000. Pictures of this work and graphic descriptions, told by an engineer who understands the nature of it, will make interesting articles for the readers of the Gillette engineering publications, for whose information Mr. V. J. Brown, associate editor, made this journey.

The first article will appear in the November issue of *Engineering and Contracting*.

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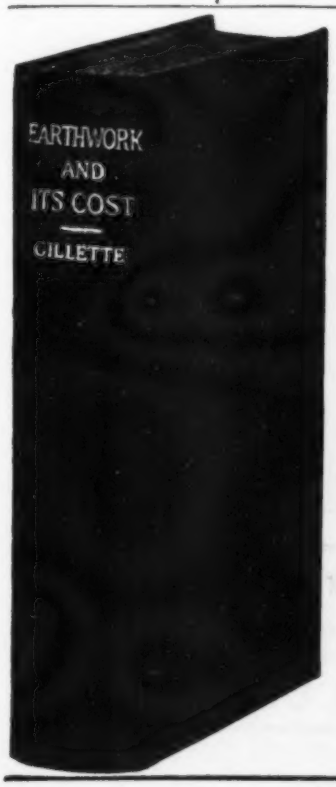
4230 Tables, Transfer
4235 Tampers, Asphalt
4240 Tampers, Backfill
4247 Tampers, Trench
4250 Tank Level Controller
4255 Tanks
4260 Tanks and Towers, Water
4265 Tanks, Oil Storage
4270 Tanks, Sand Settling
4275 Tanks, Sprinkling
4280 Tanks, Steel (Fuel and Water)
4285 Tapes, Metallic
4290 Tapping Machines, Water and Gas Mains
4295 Tapping Machine Sleeves and Valves
4300 Tar, Road
4305 Tar and Pitch, Paving
4310 Teeth, Dipper and Bucket (Manganese Steel)
4312 Teeth, Scarifier
4315 Templates, Subgrade
4320 Templets, Stripe-Off
4325 Templets, Wood, Paving Gauge
4328 Templates
4332 Tents, Awnings and Tarpaulins
4335 Testing Machines, Cement
4340 Testing Machines, Cement and Road Materials
4345 Tests, Road Material
4350 Ties, Steel
4355 Tile, Building
4360 Tile, Cement
4365 Tile, Drain
4370 Tile, Rubber
4372 Timber
4374 Tires
4380 Tools, Asphalt Paving
4385 Tools, Caulking
4390 Tools, Draining and Ditching
4395 Tools, Hand, Blacksmith
4400 Tools, Hydraulic
4405 Tools, Mechanics
4410 Tools, Pipe Jointing
4415 Tools, Pneumatic
4420 Torches, Gasoline
4425 Torches, Kerosene
4430 Torches, Thawing, Oil & Kerosene
4433 Towers & Chuting Equipment
4435 Track, Industrial & Portable
4440 Track Pull
4450 Tracks, Rail
4460 Tractors
4470 Tractors, Caterpillar, Crawler Traction
4475 Tractors, Industrial
4490 Tractors, Wheel
4500 Traffic Signals
4505 Treads, Traffic
4510 Trailers
4525 Trailers, Logging and Pole
4530 Trailers, Motor Truck
4540 Tramways (Aerial Wire Rope)
4545 Transits & Levels
4547 Transmission
4550 Trench Machines
4555 Trench Machine Parts (Manganese Steel)
4560 Trolleys, I-Beam
4563 Truck Tractor
4573 Trucks, Road, Batch Box
4575 Trucks, Dump
4580 Trucks, Machinery
4585 Trucks, Motor
4595 Trucks, Portable Machinery
4597 Truck Tires
4605 Trusses, Standard (Steel)
4607 Tubs, Filter
4610 Turbine Gears
4615 Turbine (Hydraulic and Steam)
4620 Turnbuckles
4625 Turnouts
4630 Turntables, Industrial Railway
4635 Turntables, Motor Truck
4640 Unloaders, Ballast
4645 Unloaders, Car and Wagon
4650 Unloaders, Coal, Stone
4655 Unloaders, Conveyor
4660 Unloading Plants
4665 Used Equipment
4670 Valve Boxes
4675 Valve Control, Electric (Mechanical)
4680 Valve Indicators
4685 Valves, Altitude and Regulating
4690 Valves, Air and Vacuum
4695 Valves, Angle, Check, Gate, Glove, Etc.
4700 Valves, Automatic Air
4705 Valves, Fire Service
4710 Valves, Float
4715 Valves, Flush
4720 Valves, Foot
4725 Valves
4730 Valves, Gate
4732 Valves, Pipe
4733 Valves, Water Relief
4735 Ventilators
4740 Ventilators, Shop, Roundhouse
4745 Wagons, Asphalt
4750 Wagons, Dump
4755 Wagons, Dump, Horse Drawn
4760 Wagons, Sprinkling
4765 Wagons, Stone Spreader
4770 Wainscoting & Capping
4775 Wall Coping (Vitrified Salt Glazed Clay)
4780 Washers
4785 Washing Plants, Sand & Gravel
4795 Water Filters
4805 Water Leak Locating Instruments
4810 Water Level Recorders
4815 Water Main Cleaning
4820 Waterproofing, Oil, Asphalt
4825 Waterproofing (Compounds and Material)
4830 Water Purification (Control)
4831 Water Softening Equipment
4840 Water Sterilization (Violet Ray)
4850 Water Works Supplies
4855 Weed Killer
4860 Welders, Electric
4865 Welding & Cutting Equipment
4870 Well Casings (Metal)
4875 Well Contractors
4885 Well Equipment (Artesian Cylinders)
4890 Well Heads
4895 Wells
4905 Wheelbarrows
4925 Wheels, Metal
4930 Wheels, Rubber Tired
4933 Wheels, Tractor
4935 Winches
4940 Winches, Motor Truck
4943 Windlasses
4950 Window Sills
4955 Windows (Steel, Hollow Windows, Wire glass, Fireproof)
4960 Wire and Cable
4965 Wire Brushes (Pneumatic)
4970 Wire, Leading and Connecting
4975 Wire Rope and Fittings
4980 Wire, Steel
4985 Wood Boring Machines, Pneumatic
4990 Wood Preservatives
4995 Wrenches and Ratchets



Gillette

Earthwork and Its Costs

By HALBERT P. GILLETTE

Third edition. 1346 pages, pocket size, flexible, illustrated—$6.00.

This is, in fact, a new handbook of earth excavation. Every phase of such work is carefully analyzed in this book, and detailed cost data on every operation are presented. These cost data are so itemized that by proper rate substitutions they may be used by engineers and contractors as cost formulae under all conditions.

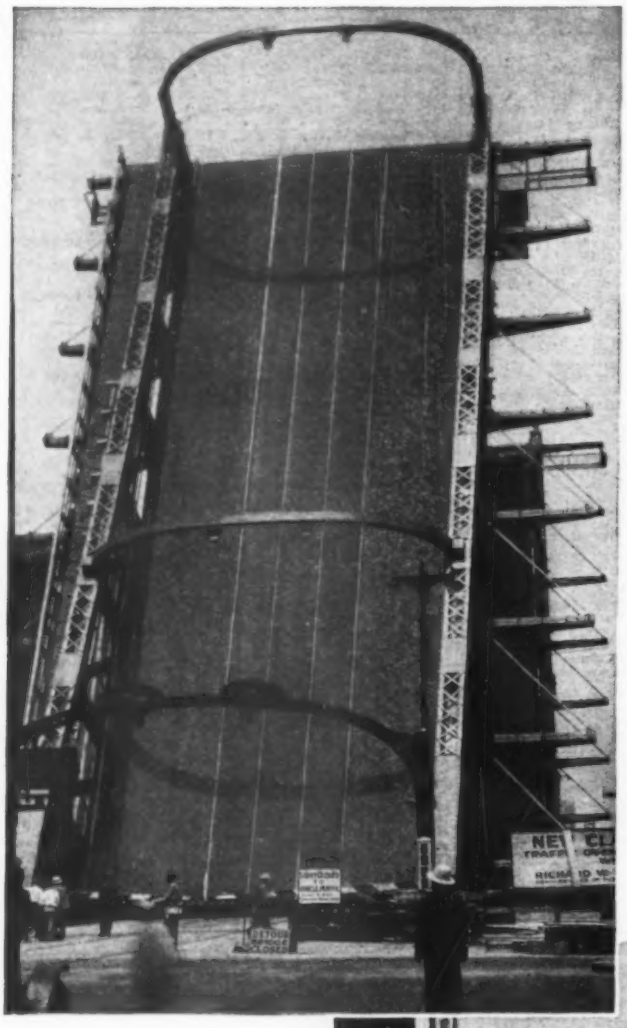
This book should be in the hands of every man who is in charge of "moving dirt", whether with pick and shovel, plow and scraper, steam shovel and dredge, or any other tools for digging and conveying dirt.

CONTENTS. I.—Properties of Earth. II.—Measurement, Classification and Cost Estimating. III.—Boring and Sounding. IV.—Clearing and Grubbing. V.—Loosening and Shoveling Earth. VI.—Spreading, and Rolling Earth. VII.—Hauling in Barrows, Carts, Wagons and Trucks. VIII.—Methods and Costs with Elevating Graders and Wagon Loaders. IX.—Methods and Costs with Scrapers and Graders. X.—Methods and Costs with Cars. XI.—Methods and Costs with Steam and Electric Shovels. XII.—Methods and Costs with Grab Buckets and Dump Buckets. XIII.—Methods and Costs with Cableways and Conveyors. XIV.—Methods and Costs with Dragline Scrapers. XV.—Methods and Costs of Dredging. XVI.—Methods and Costs of Trenching. XVII.—Ditches and Canals. XVIII.—Hydraulic Excavation and Sluicing. XIX.—Road and Railroad Embankments. XX.—Design and Construction of Earth Dams. XXI.—Dikes and Levees. XXII.—Slips and Slides

GILLETTE PUBLISHING COMPANY

221 East 20th Street, Chicago, Illinois

Once More SERVICISED Fibrated Asphalt Planking Is Selected for a Chicago Bridge



To be a Chicago River Bridge is to have a real job, handling the pound of heavy traffic, with seldom a chance to rest a minute by getting up to stretch.

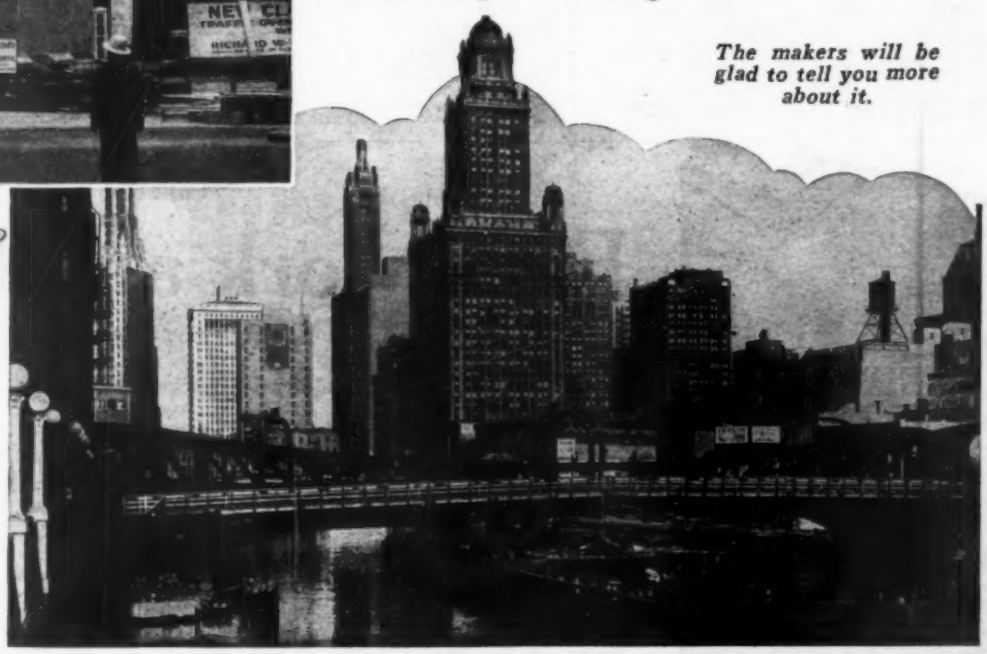
Some bridges have their choice of traffic, mostly the *bon-ton* kind with soft, speeding rubber cushions for wheels. Not so on Clark Street, Chicago. There, if you are the bridge crossing the main stretch of the river, north and south, you must be tough, strong and patient, with real stability, and with ability to stand the gaff,—the jar and pound, all of every day and night, hour after hour, of thousands upon thousands of wheeled vehicles —all kinds.

There they stream, head to tail,—passenger cars, Fords and rattlers; ten-ton motor trucks and five-ton wagons pulled by two tons of horseflesh; double truck sixty foot street cars with the "hoi polloi" jamming them to the roofs and hanging on somehow. Thud, crash, bang,—sunrise to sunset, sunset to sunrise, and the end of the business day worst of all.

That's why the engineers said, "Put Servicised Fibrated Asphalt Planking on Clark Street Bridge." It will stand the gaff. It's not slick or slippery; it's waterproof; it deadens noise and vibrations; it's economical, wears a long time and smooths out and heals itself under traffic.

And the new Clark Street Bridge will have an easier time than the old one, though it must take more abuse, all because it's covered with Servicised Fibrated Asphalt Planking.

The makers will be glad to tell you more about it.



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Expansion Joints for Roads, Streets, Sidewalks, Buildings
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Rail Filler and Track Insulation
Sewer Pipe Jointing
Industrial Flooring
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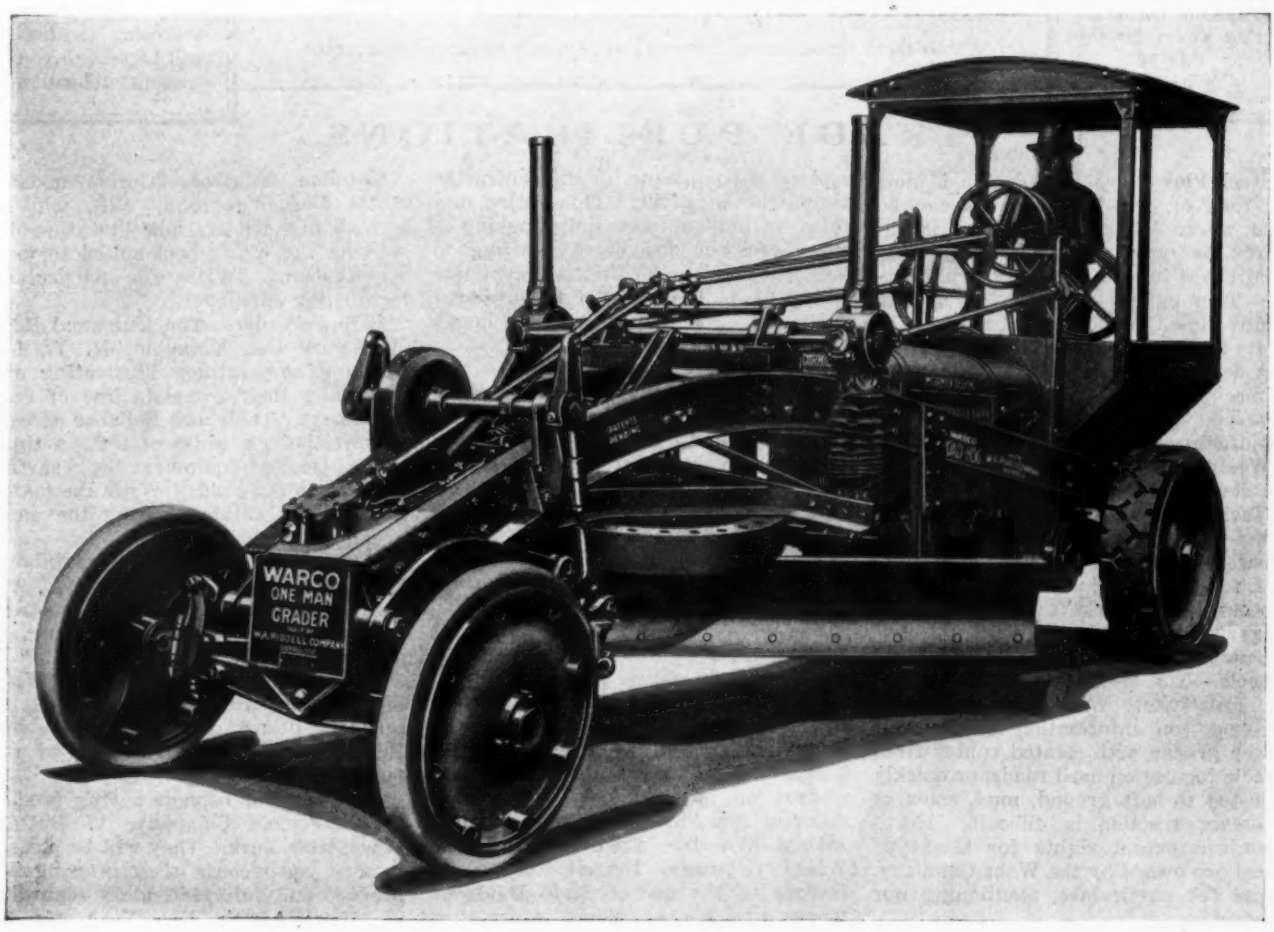
Do you mention ROADS AND STREETS when writing? Please do.

NEW 1929 WARCO ONE MAN GRADER



FAMOUS OVER NIGHT

. . . *and justly so*

The W. A. Riddell Company's exhibit at the Road Show—the new improved one man Grader—the new rear crawlers—the new 1929 Alwatrac, prompted enthusiastic expressions of commendation on all sides.

This unprecedented reception is a forerunner of the inevitable success of these machines. Their popularity is assured.

The new 1929 Warco one man Grader with newly designed circle and new screw lift (patent applied for) has many excellent features which place it far ahead of any other Power Grader. Subjected to strenuous tests under every possible condition the Grader has proved its worth. Six months ago it was ready for production. In order to be able to introduce a new one man Grader which would be the acme of perfection the machine has been withheld from the market until its perfection was an absolute certainty.

The new 1929 Warco one man Grader is now under production—it will be available for spring delivery—complete specifications and prices furnished on request.

See us at the Southwest Road Show and School, Wichita, Kansas, Feb. 26th-March 1st, 1929. Space No. 109 and 113.

Warco Products do the Job — Easily . . . Quickly . . . Efficiently

W. A. RIDDELL COMPANY

BUCYRUS, OHIO, U. S. A. **Dept. D.**

Road Contractors, Engineers, City and State Highway Officials

Valuable Information Yours for the Asking

Write Now

Catalog Service

Useful Equipment Information

Watch these trade announcements for new and improved equipment

By writing the manufacturers named and mentioning this magazine, copies of the following catalogs will be sent to you without obligation

TRADE PUBLICATIONS

Steel Plow—The Wiard 2-in-1 plow for road or construction work can be used where the strongest plow is required, or by removing the plate below mold board it becomes an efficient rooter. This equipment is made by the Wiard Plow Company of Batavia, N. Y. Write to them for literature illustrating and describing the work of this piece of machinery. We would be pleased to have you give our name when writing manufacturer.

Westphalt.—The trade name given the new method for construction or resurfacing hot-lay sheet asphalt without a hot-mix plant. Write to the West Process Pavement Co., Inc., Louisville, Ky., for full particulars regarding this process. Kindly use the name of our magazine, if writing.

Grader with Cleated Rubber-Tired Wheels.—The Wehr Company, 547 30th St., Milwaukee, Wis., will be pleased to send you information about their power grader with cleated rubber-tired wheels for use on hard roads, or quickly adjusted to soft ground, mud, snow or wherever traction is difficult. North American patent rights for this type wheel are owned by the Wehr Company. Write for particulars, mentioning our publication.

Pavers, Mixers, Pumps, Etc.—"A Bulletin for Every Need" might well be the title of the series of booklets just received from the Chain Belt Company, Milwaukee, Wis. A very attractive one is called "Setting the Pace for Its Entire Class" and is devoted to detailed description and illustration of Rex 10-S. This is catalog No. 173 and tells in terms of design, performance and value just what this machine is and what should be expected of it, No. 164, No. 177, No. 174, No. 161, No. 168 and No. 170 all describe the different types and sizes of the Rex mixers. Ask the manufacturer for this series of booklets on the Rex mixers. Catalog No. 172 is called "Again for '29," and contains 32 pages of information about the Rex paver and mechanical man, powered by six-cylinder Waukesha engine. Secure a copy of this catalog. Bulletins No. 180, No. 181, No. 176 and No. 179 describe Rex pumping equipment. The Rex plunger force pump for trench and foundation work. The Rex centrifugal for handling a larger quantity of water than can be handled by the Rex diaphragm or plunger force pump. Specifications and equipment of the Rex diaphragm are given in Bulletin No. 176, and No. 179 describes the road pump, a piece of equipment for the contractor to match the paver. This entire machine is built in one unit, making a close, compact design. If writing to the manufacturer for this very complete series of bulletins, or for whichever ones best meet your requirements, kindly mention our publication.

Bins and Hoppers.—Write to the Butler Bin Company, Waukesha, Wis., or any of their branches in the principal cities of this continent and South America for information in regard to their products and service. Ask for particulars about their steel bins, and their application to construction and road building problems. Kindly mention our magazine if writing for information.

Shovels.—The Byers Machine Co., Ravenna, O., will send you upon request new literature describing construction and performance of their Byers Independent rope crowd shovel. Your inquiry will bring complete information and records of work accomplished on specific jobs. If writing manufacturer kindly mention our paper.

Dual Wheels.—Write to the Budd Wheel Company, Detroit, Mich., for records of the use of Budd Duals on trucks and buses. Their information relates to increased load capacity and decreased tire costs. Kindly give the name of our magazine if writing manufacturer.

Portable Compressors and Pneumatic Tools.—Bulletin 797, recently issued by the Chicago Pneumatic Tool Company, 6 E. 44th St., New York City, gives full description of the CP portable compressors equipped with simplate valves and auto-pneumatic throttle, which slows down the engine when the compressor unloads. The CP-10 rock drill, particularly suited to heavy sinking, hand ground and long down-hole drilling, is described in Bulletin No. 850. If writing for these catalogs, kindly mention our paper.

Rex Pavers.—Write to the Chain Belt Company, 729 Park St., Milwaukee, Wis., for printed matter on their pavers. The engineering experts of this company are ready to help you solve your paving problems, write them for information. Kindly give the name of our publication.

Engines.—Four and six-cylinder Blue Streak engines, manufactured by the Climax Engineering Company, 77 W. 18th Ave., Clinton, Ia., are described as to construction and industrial uses in the catalogs issued by this company.

Gasoline Engines.—The Waukesha Motor Co., Waukesha, Wis., will be pleased to send you new literature describing the motor best suited to your requirements. Write for particulars, mentioning our paper.

Chip Spreader.—The Universal Road Machinery Co., Kingston, N. Y., has issued a new catalog illustrating and describing their complete line of road machinery. Their new Reliance spreader spreads to a width of 8 ft., a time-saving piece of equipment for resurfacing bituminous roads. Write the manufacturer for catalog, giving the name of our magazine.

Shovels.—The Universal Power Shovel Company of 15841 Second Blvd., Detroit, Mich., have brought out two new models. Model "B" is a ¾ swing, ⅜ capacity shovel, while model "CF" is a full revolving ⅜ yd. capacity. Write to the manufacturer for illustrated, descriptive literature on these new machines, mentioning the name of our publication.

Texaco.—The asphalt paving product of the Texas Company, 17 Battery Place, New York. They will be pleased to send you records of cities using this product and full particulars regarding it. If writing the New York office, or any of the branches in all the principal cities, kindly mention our magazine.

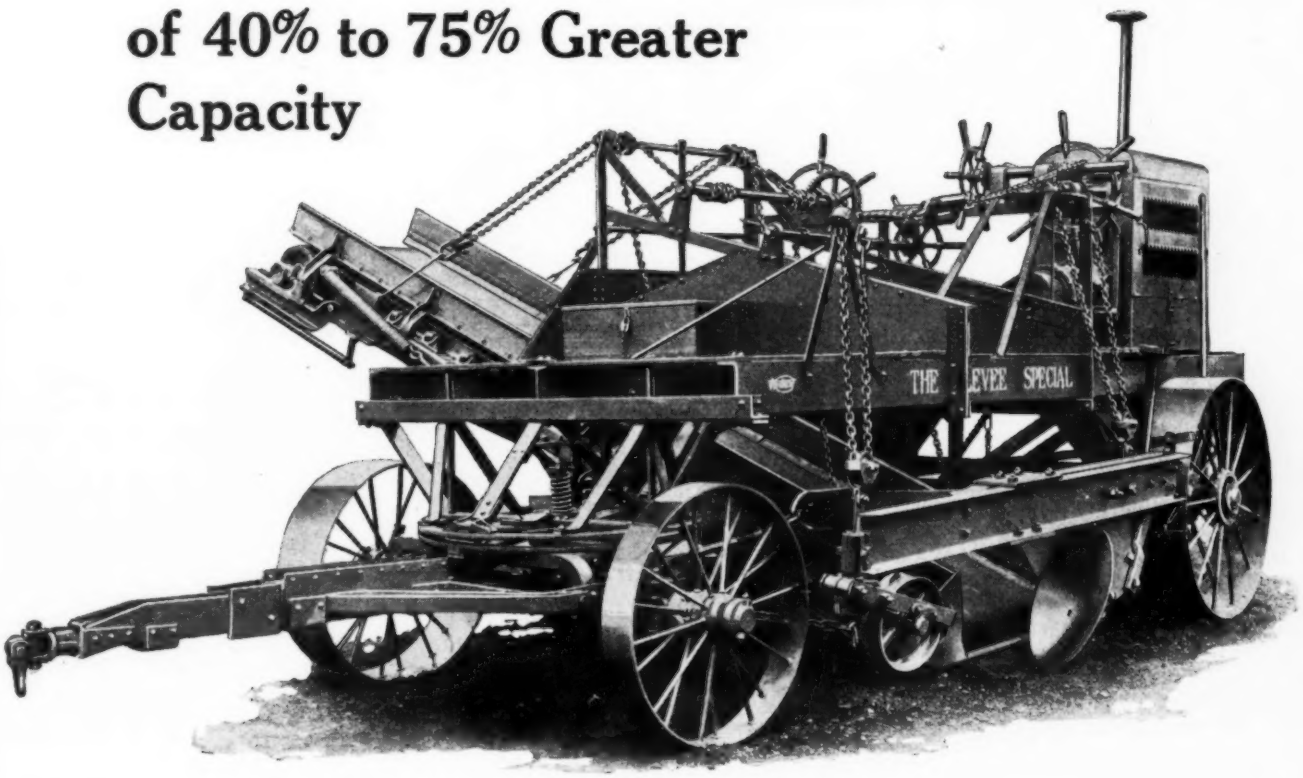
Radiators.—Young heavy duty radiators, built by the Young Radiator Company for trucks, tractors, power units, cranes, shovels, draglines, compressors, hoists, pavers, etc., are fully described in literature issued by the manufacturer. The engineering staff of this organization will be pleased to advise with you as to your special needs. Write to the manufacturer at Racine, Wis., or the western representative, Mr. S. Clyde Kyle, Rialto Bldg., San Francisco, Cal. If asking for information, kindly mention our magazine.

Dump Bodies.—Catalog No. 10, just issued by the Wood Hydraulic Hoist & Body Company, Detroit, Mich., illustrates and fully describes the construction and advantages of the Wood steel dump bodies. Low maintenance cost, long life and satisfactory service are the points brought out in regard to this equipment. Write to manufacturer for catalog, giving the name of our publication.

Motors.—Wisconsin motors, built for heavy duty for industrial machinery, trucks, tractors, etc., are described in new literature issued by the Wisconsin Motor Co., Milwaukee, Wis. Write to

A New Elevating Grader

of 40% to 75% Greater Capacity



THE LEVEE SPECIAL

THE Levee Special differs from other elevating graders in that the belt is driven by a four-cylinder gasoline motor mounted on the rear of the machine. The tractor is relieved of the load required to elevate the dirt. The capacity of the Levee Special runs from 40% to 75% greater than the same size machine on which the belt is driven from the rear axle.

The one piece elevator, automatic belt tightener, wide clearance on the belt and many other features are explained in Bulletin 29 B. Q.

Write for a copy.

Western Wheeled Scraper Company
Aurora, Illinois

WESTERN

DUMP CARS AND GRADING EQUIPMENT

the manufacturer for information concerning this reliable equipment. We would appreciate it if you would mention our name if asking for information.

Reinforcing Fabric.—Literature of the Wickwire Spencer Steel Co. fully describes Clinton fabric for reinforcing every form of concrete construction. The engineering department of this company will be pleased to help you solve your reinforcing problems. Write to their New York office, 41 E. 42nd St., or to their branches in any of the large cities for information. In writing, kindly give the name of our paper.

Wheeling Traveling Crusher, described in the literature of the Wheeling Mold & Foundry Co., Wheeling, W. Va., gives data concerning their crusher, which operates while traveling or standing, and of the tractor, which can be used for other duties. Instances are given to show the increased output because of the steady operation, and at lowered costs. Write for information concerning this equipment, mentioning our magazine.

Quikard Cement.—Write to the Ash Grove Lime & Portland Cement Co., 330 Grand Avenue Temple, Kansas City, for particulars regarding their quick hardening cement, which permits new concrete to be put into service within 24 hours. They will be pleased to furnish data and specific instances of the satisfactory use of this product. If writing for information we would appreciate it if you would mention our magazine.

Treated Timber.—Let Ayer & Lord Tie Company of Chicago send you information regarding their treating plants for furnishing treated timber for bridges, piling, cross ties, posts, etc., "From the Tree to the Job." Treating plants are located at Carbondale, Ill.; Grenada, Miss.; Louisville, Ky.; North Little Rock, Ark., and Montgomery, Ala. If seeking information about this product, write to the manufacturer, or one of their stations, mentioning our magazine.

Tarvia.—A product for road construction, repair and maintenance manufactured by The Barrett Company, with offices in all the principal cities of the United States and Canada. Write to any of the branches of this company for help in solving your road problems, they will be glad to serve you. Kindly give the name of our magazine if writing the manufacturer.

Tractors.—The Bates Manufacturing Company of Joliet, Ill., has issued a new catalog giving details as to construction and performance of their tractors. Made in three sizes, No. 28, No. 40 and No. 70. If requesting copy of this catalog, kindly give the name of our publication.

Truck Cranes.—The full revolving motor truck cranes, built for speed, endurance and ease of operation, manufactured by the Bay City Foundry & Machine Company, of Bay City, Mich., is fully described in their literature. Ask for special information regarding their type R truck crane. Please use the name of our paper if writing manufacturer.

Magneto.—A waterproof, dust-proof, super-energy magneto built by the Robert Bosch Magneto Co., Inc., 3605 E. Queens Blvd., Long Island City, N. Y., for industrial gas engines. They will be pleased to send you full particulars regarding this equipment, as well as a copy of their booklet "Ignition Briefly Described." If writing for literature, kindly give the name of our paper.

Transmissions, Clutches and Controls.—The Brown-Lipe Gear Co., Syracuse, N. Y., will be pleased to have their engineers help you in solving your power transmission problems. Write to the company or one of their branch offices in the principal cities for information. We would appreciate it if you would mention our paper if writing.

Engines and Power Units.—Buda gasoline engines and power units for equipping shovels, cranes, draglines, hoists, compressors, dredges, etc., fully described and illustrated in literature of the Buda Company, Harvey, Ill. State your requirements and they will be pleased to send you full particulars to meet your needs. If writing, kindly give the name of our magazine.

Buffalo-Springfield Roller.—Literature from the Buffalo-Springfield Roller Company, Springfield, O., will be sent upon request, describing and illustrating in detail this equipment. Will you kindly give the name of our magazine when requesting literature?

Unloaders, Conveyors and Spreaders.—Write to the Burch Corporation, Crestline, O., for a copy of their new catalog describing in detail their products. Their literature describes the time, labor and money-saving features of this equipment. We would appreciate the mention of our publication, if writing the manufacturer.

Utility Six-Wheel Unit.—For installation on trucks of every make and for every purpose. Can be installed by any automotive mechanic with ordinary tools. Write to the Utility Trailer Manufacturing Co., Box 260, Arcade Station, Los Angeles, for literature and full information concerning this equipment. Distributors are located throughout the country. Kindly mention our name if writing the manufacturer.

Concrete.—Write to the Portland Cement Association, 33 W. Grand Ave., Chicago, if planning highways to meet modern congestion problems. Their engineers will be glad to advise with you. Two-level intersections are now possible even in closely built business districts.

Screening and Crushing Outfit.—The New Holland Machine Company, 100 Franklin St., New Holland, Pa., offer a very practical, light running outfit, at a reasonable price. Write for particulars, mentioning our magazine.

Ames Ten-Ton Road Roller.—A very comprehensive and convincing broadside has been received from the Ames Iron Works division of the Pierce, Butler & Pierce Manufacturing Corporation, Oswego, N. Y. The illustration of this six-cylinder road roller gives evidence of strength, weight and power. The longitudinal sectional view, which is the center spread, points out the outstanding features of this equipment. Specifications are listed on the back page: Frame, wheel base, engine (lubication and cooling), clutch, transmission, differential, rear axle, steering, controls, front roll, rear roll, brakes, scarifier and equipment. Investigate this machinery, mentioning the name of our magazine when writing manufacturer.

Motor Trucks.—A very attractive series of folders has just been received from the Larrabee-Deyo Motor Truck Company, Inc., Binghamton, N. Y. The bulletins describe in detail Models 20, 30, 40, 50, 60 and 70, giving specifications and illustrations of outstanding features. These trucks are made in capacities of from one to five tons. A standard line of bodies is carried in stock for each model, but special bodies can be built to order. Tank and dump bodies can be supplied for all models. These Larrabee Speed Six Commercial chassis, with this wide range of capacities and consisting of six basic models, were designed around well known units and acceptable to the trade. A considerable amount of interchangability in the various units was used in their construction. This interchangability of parts simplifies the service problem. Write to the manufacturer for a complete set of the new bulletins, kindly mentioning the name of our magazine when writing.

Crusher.—The Allis-Chalmers Company, of Milwaukee, Wis., would be pleased to send you literature describing their Newhouse Style "B" Crusher, built with large receiving opening, short rigid main shaft and rapid crushing stroke, to produce high capacities per crushing unit. Made in three sizes: 7-in., 10-in. and 14-in. receiving opening. The machine is self-contained with vertical motor. If writing for particulars, kindly give the name of our publication.

Tractors.—Write to the Monarch Tractors Corporation, at Springfield, Ill., a subsidiary of the Allis-Chalmers Mfg. Company of Milwaukee, for full particulars concerning the Allis-Chalmer-Monarch Tractors "50" and "75," built for every need, and all seasons.

Shovel, Dragline, Etc.—The Harnischfeger Corporation, 3896 National Ave., Milwaukee, Wis., will be pleased to send you literature regarding their 3½ cu. yd. capacity diesel powered shovel dipper, or dragline of same capacity. The revolving base, side frames, car body and corduroy frames are heavy single piece steel castings. All bearings are

$1125.00

F. O. B. Peoria
Illinois

The price of the new Model Ten "Caterpillar" Tractor

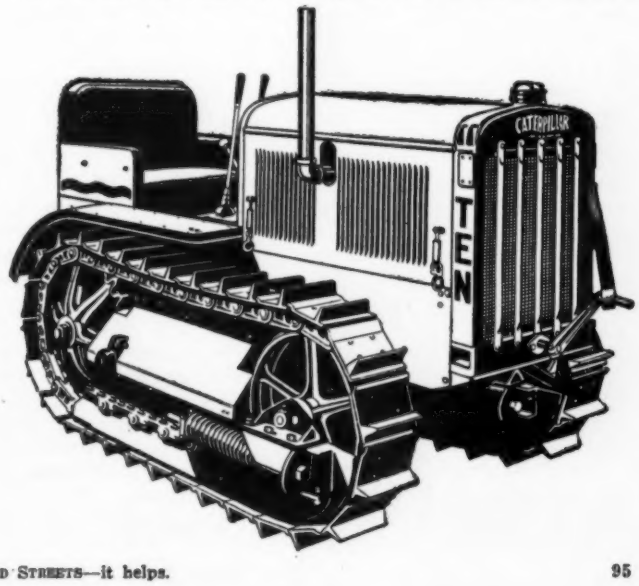
Little brother to the big "Caterpillar," a sturdy new track-type tractor in a smaller size! Balanced power and traction...a 14 h.p. engine delivering 10 h.p. at the drawbar... destined to bring "Caterpillar" fame to thousands of smaller farms and to new users in industry!

With a track that bridges soft going (and without packing) with all "Caterpillar" qualities of ruggedness and dependability.

Caterpillar Tractor Co.
EXECUTIVE OFFICES: SAN LEANDRO, CALIFORNIA
Sales Offices: Peoria, Illinois • 50 Church St., New York • San Leandro, Calif.
Holt Combined Harvesters • Russell Road Machinery
"Caterpillar" Tractors

CATERPILLAR
REG. U.S. PAT. OFF.
TRACTOR

THE NEW MODEL TEN



of the heavy duty roller type. This equipment, provided with steering brakes, can be maneuvered as easily as a small machine. Ask for description of Model No. 900, giving the name of our magazine if writing the manufacturer.

Crawler Dump Wagon.—Write to the Western Wheeled Scraper Co., Aurora, Ill., for a copy of Bulletin 28-GQ, describing and illustrating the Western crawler dump wagons, 5-yd., 7-yd. and 10-yd. capacities, for solving your earth moving problems. Kindly mention our publication if writing for particulars.

Compressors, Rock Drills, Hoists, Breakers and Spaders, Drill Sharpeners.—Products of the Sullivan Machinery Company, 92 E. Adams St., Chicago, are described and illustrated in their new booklet "Speed Up With Air." Write for a copy of this, using the name of our publication.

Calcium Chloride.—The Solvay Sales Corporation have for free distribution booklets on "Concrete Curing" and "Dust Laying." Their product, Solvey Calcium Chloride, is recommended for making stronger and denser concrete in any weather, insures profitable work in freezing temperatures. Ask for Bulletins 2251 and 2256.

Excavators.—Buletin No. 60, a handsome 32-page booklet, has just been received from the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill. This company, manufacturers of crawling-tread shovels, cranes, draglines, ditchers and skimmers, road-wheel cranes, truck cranes, locomotive cranes, gantry cranes, clamshell and orange-peel buckets, etc., has representatives in all the principal cities. The bulletin contains complete descriptions and illustrations of their excavating and material-handling equipment with specification tables. Write for a copy of this bulletin, mentioning the name of our magazine.

Dump Trucks.—The LeBlond Schacht Truck Co., Cincinnati, O., has issued a very attractive folder giving details concerning their 2, 3 and 4-yd. road-makers. These are 6-cylinder Waukesha motors, St. Paul underbody hydraulic hoists, Crescent convertible cab, 7 Budd disc wheels, pneumatic tires, duals rear, electric generators, battery, lights and starter.

Center Drive Shovel.—The Lorain-55, the new center drive shovel built by the Thew Shovel Company, Lorain, O., with branches in the principal cities of the country, is fully described, giving specifications and data and pictures of this new Thew 1-yd. center drive crane, clamshell, shovel, dragline machine of the same design and construction as the Lorain-75. Write for bulletin on Thew Center Drive—Lorain-55. We would appreciate it if you would use the name of our publiaction if writing manufacturer.

Power Shovels.—A very attractive new bulletin has just been issued by the Bay City Dredge Works, Bay City, Mich., giving specifications and illustrations, and pointing out the distinctive features of the new Model "K" light, half-yard, full revolving Bay City shovel. Circular No. 28, just issued by the same company, describes the complete line of power shovels, including the Bay City tractor shovel, 10-ton, ⅜-yd., ¾-swing, full crawler mounted, the Model "R" heavy duty, ¾-yd., 26-ton, full-revolving, convertible, full-crawler shovel, as well as Model "K" mentioned in Bulletin K-1.

Silicate of Soda.—"Curing Concrete Highway with Grasselli 'R-B' Silicate of Soda" is the title of a very attractive and useful booklet just issued by the Grasselli Chemical Co., 629 Euclid Ave., Cleveland, O. The front of the book contains a list of all the branch offices and warehouses of this company in various parts of the country and at the back there are several pages left blank for the jotting down of useful memoranda. Sodium silicate, commonly known as water-glass, is manufactured by a fusion of white sand with soda ash. This produces a glass-like product, but soluble in water under high pressure and temperature. As this chemical is used for a variety of purposes great care must be exercised in fusing, as different proportions produce different results. Following this introduction the booklet treats specifically the Grasselli "R-B," a special product silicate of soda for the curing of concrete. A history of this method is given, method of using, equipment needed, efficiency, economy, simplicity, —all these and other topics are discussed, and a list is given of road contractors who have met with success in the use of this product. The manufacturer will be pleased to send you a copy of this booklet. If writing for a copy, we would appreciate it if you would mention our publication.

Air Compressors.—Two new folders have just been received from The Buhl Company of DePere, Wis., containing many illustrations and full descriptions of their several sizes and types of compressors. They are supplied with any style mounting, such as truck with steel wheels, steel wheels with rubber tires, trailer mounted, skid mounted or mounted on Ford truck or standard railway car. All parts, except the crankshaft unit, in any one size or type are interchangeable on all sizes and types. Write to the manufacturer for copies of this literature, kindly mention the name of our paper.

Trackson Bulldozer.—Write to the Trackson Company, 500 Clinton St., Milwaukee, Wis., for a copy of Form 174, describing the power, speed and economy resulting from the use of this equipment. This unit is built for mounting on the Model DH Trackson McCormick-Deering crawler-tractor. It is constructed of heavy steel to withstand the unusual strains, twists and shocks of dirt-moving. Illustrations, specifications and other information is given in this circular. Write to the manufacturer for a copy, mentioning the name of our magazine.

Graders.—Catalog R-29, issued by J. D. Adams & Company, Indianapolis, Ind., contains full descriptions and illustrations of the Adams graders. The manufacturer will be pleased to send you a copy of this catalog upon request. Kindly mention our magazine, if writing.

Concrete Heaters, Water Heaters, Torches, Etc.—Ask the Aeroil Burner Co., Inc., West New York, N. J., for a copy of Bulletin No. 72R, containing full descriptions and illustrations of their products. We would appreciate it if you would mention our name if writing manufacturer.

Magnetos.—The American Bosch Magneto Corporation, Springfield, Mass., will be pleased to send you literature and full particulars concerning their product for equipping machinery. Ask for catalog describing Type ZR-4 and ZR-4-IC. Kindly give the name of our magazine if writing for information.

Traffic Plates.—Blueprint circular describing installation and uses for the Neverslip traffic plates, products of the American Pressed Steel Company, Philadelphia, will be sent upon request. These plates are designed for new or old bridges, to increase the life of the bridge, eliminate vibration, and reduce maintenance costs. If writing for information, please give the name of our paper.

Wire Fabric.—For reinforcing concrete roads and streets, write to the American Steel & Wire Company for literature descriptive of this product, which can be secured in sheets or rolls for convenient handling. Full information in recent literature, write to the manufacturer, 208 S. LaSalle St., Chicago, mentioning the name of our publication.

Road Roller.—The Ames Iron Works, Oswego, N. Y., a division of the Pierce, Butler & Pierce Mfg. Co., will be pleased to send you new literature on the Ames road roller. If requesting this information, kindly mention our magazine.

Steel Post Road Guard.—The Anchor Post Fence Company, Eastern Ave. and Kane St., Baltimore, Md., will be pleased to send you full information regarding their new steel post road guards. No digging is required for setting these posts, which are simply driven into the ground and a few blows on the anchor set the posts. Chain link fabric is clipped to posts. This company has branch offices in all the principal cities where information can be secured, or by writing direct to the manufacturer. Kindly mention our publication if writing for particulars.

Rocker Bodies.—Roller rocker bodies for equipping trucks are described in literature issued by Anthony Company, Streator, Ill. These bodies are made

Dig ▲ Move ▲ Load at Less Cost

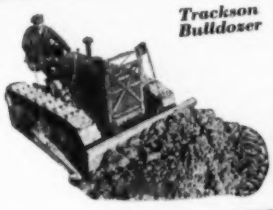
TRACKSON TRACTOR EQUIPMENT

WHERE there's digging, moving or loading to be done—this Trackson equipment is an ogre for eating up jobs. The Low Lift Shovel and High Lift Loader, used with the Trackson Full Crawler, have proved their economy by cutting costs on 60 different uses! On the ordinary excavating job they frequently replace from 4 to 10 men and as many as 4 teams of horses. By handling from 80 to 160 yards per day, the Trackson Shovel unit often pays for itself in a few weeks. Besides excavating, this equipment handles anything movable —dirt, rock, coal, gravel, cinders, sand, building materials, clay, etc.

Wherever there is need for eager, irresistible power, and speedy, agile performance, you will find Trackson Shovels, Loaders, Cranes, Bulldozers and Crawlers saving time, men, money.

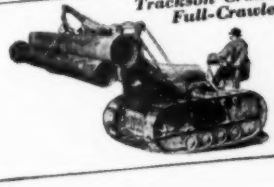
Let us tell you how Trackson Tractor Equipment can solve your problems and show a definite, daily earning capacity for you on the job.

Put it up to us . . . today.

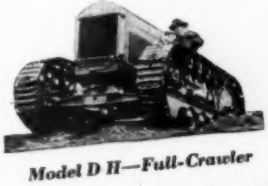


Trackson Bulldozer

Trackson Crane



Trackson Crane with Full-Crawler



Model D H—Full-Crawler

Trackson Company
FULL-CRAWLERS & TRACTOR EQUIPMENT
533 CLINTON ST. MILWAUKEE, WIS.

in 1-yd., 1½-yd., 2-yd. sizes, in gravity or hand hoist. They will be pleased to help you in choosing bodies best suited to your needs. If writing the manufacturer, kindly give the name of our paper.

Armco Culverts. — Armco Culvert Manufacturers' Association of Middletown, O., have issued a booklet describing the Armco paved invert culverts and explaining the balanced design used in this product. Write for Bulletin H 33, which the manufacturer will be pleased to send you. Kindly use our name when writing.

Highway Surfacer.—The Berg concrete surfacer is a fast worker in producing an even surface, cutting down high spots, uneven expansion joints and repaired patches. It requires but one man to operate it. Write to the Concrete Surfacing Machinery Company, Winton Place, Cincinnati, O., for full particulars. We would appreciate it if you would mention the name of our magazine when writing.

Tar and Asphalt Heaters.—Connery & Company, Inc., 3996 N. Second St., Philadelphia, Pa., issue a "Blue Book" describing and illustrating this equipment. Style J comes in capacities from 50 to 165 gal., while style B-2 is made in capacities for 300, 400 and 550 gal., both are oil burning kettles. Style A-1 maintenance heater is made for 65, 125, 150, 175 and 225 gal. and burns coal, coke or wood. Ask the manufacturer to send you a copy of this book, giving the name of our magazine.

Lanterns.—The Dietz Little Giant Lanterns with red globes for safety signals will burn 70 hours without refilling. The manufacturer will be pleased to send you information concerning these lanterns. R. E. Dietz Co., New York

Calcium Chloride.—Dowflake is effective in concrete curing, gravel road patching and ice removal. Write to the manufacturer for a copy of booklet "How to Maintain Roads," kindly giving the name of our publication. Write Dow Chemical Co., Midland, Mich.

Graders.—"How Better Machinery Brings Better Highways" is the title of a booklet issued by the Ryan Manufacturing Co., 13501 Baltimore Ave., Chicago. This company and the C. D. Edwards Mfg. Company of Albert Lea, Minn., have consolidated and are now interested in the machinery put out by both companies. Highway officials and contractors will be interested in this book. Write for a copy, mentioning the name of our magazine.

Castings, Iron, Bronze, Steel and Copper.—The Egyptian Iron Works, Murphysboro, Ill., will be pleased to send you full information in regard to their products, which include name plates for bridges, cast iron steel rockers and shoes, cast iron drain castings, plate and angle devices. Write to the manufacturer for literature and other information, giving the name of our publication.

Techniques.—To architects and instructors in architecture and allied subjects, the Educational Department of Chas. M. Higgins & Co., 271 Ninth St., Brooklyn, N. Y., offers to send free a copy of the second edition of this publication. This booklet is illustrated by some of the most prominent illustrators in the country, and to do justice to these artists it is presented on an antique paper of very fine texture. Techniques presents a series of treatments showing the various types of work executed in Higgins' American drawing inks—the blacks and the colors. It is filled with helpful, practical information for the user of drawing inks. To students and persons outside of the profession a 25 ct. charge is made for the book.

Concrete Reinforcements. — Havemeyer electrically welded barmats and holding devices for supporting them are a product of the Concrete Steel Company, 42 Broadway, New York. Write to the manufacturer for particulars concerning them, kindly giving the name of our publication.

Rollers.—The Erie Machine Shops, Erie, Pa., have issued a new booklet on rollers, illustrating this equipment at work and giving contractors stories of results accomplished. They will be pleased to send you a copy of this literature upon request if you will mention the name of our magazine.

Oil, Tar and Asphalt Distributors.—The new catalog of the E. D. Etnyre & Company, Inc., 63 Jefferson St., Oregon, Ill., gives complete information concerning the Etnyre Model F Distributors. These distributors are built to fit any truck chassis and no experienced engineer is required for operating. They are full width distributors and this feature and others of interest are emphasized in the catalog. Write for a copy, using the name of our publication.

Trucks.—A very useful and attractive 40-page booklet has just been issued by the Autocar Company, truck manufacturers of Ardmore, Pa. This book contains much of vital interest to every contractor and highway engineer. Six pages are devoted to a comprehensive review of the outstanding recent developments by the leading manufacturers supplying the highway and contracting fields with shovels, concrete, ditch diggers, mixers, conveyors, etc. Of course, there are pictures of the Autocar trucks at work, and full descriptions as to construction and performance. If writing to the manufacturer for The Construction Book, kindly use the name of our publication.

Industrial Engines.—Write to the Lycoming Manufacturing Co., Williamsport, Pa., for their folder on series "T" six-cylinder power engines. General specifications and details and dimensional specifications on this equipment.

Four Wheel Drive Trucks.—Coleman Motors Corporation, Washington, D. C., and Littleton, Colo., will be pleased to send you literature giving detailed information concerning their four-wheel-drive trucks, Model C-25, 2 tons; Model D-40, 3 tons and Model X-100, 5 tons. These trucks are easy to steer, dependable, fast, and standard parts are interchangeable and easily available. Manufacturer will be pleased to send bulletins on these models, or answer questions concerning them. If writing for information, kindly give the name of our publication.

Hoists and Compressors.—Two new folders from the O. K. Clutch & Machinery Company, Columbia, Pa., describe and illustrate their O-K two-speed slackline cableway hoists, and dragline scraper hoists, and portable compressors for pneumatic tool operation in industrial and construction service. The hoists are available with either gasoline or electric driven engines. But two hand levers and two foot-operated brake levers are used in the operation of the cableway hoists. The compressors are of the vertical single-acting, duplex type, driven by heavy-duty gasoline engines. Write to the manufacturer for catalogs of this equipment. We would appreciate it if you would use the name of our publication when asking for further information of manufacturer.

Melting Furnaces.—For use with kerosene, coal oil or gasoline the Hauck melting furnances and combination melting furnace and torch on wheels are fully described as to sizes, purposes, weights, etc., in Bulletin 101 and 102 issued by the Hauck Manufacturing Company, 126 Tenth Street, Brooklyn, N. Y. These machines are in use by machine and repair shops, water works, pipe line contractors, gas companies, etc., and are used for melting leadite, lead-hydrolite, G-K Sewer Joint, etc. Write for these descriptive circulars, mentioning the name of our publication.

Trucks.—The Hug Company, Highland, Ill., have literature describing their industrial trucks. Ask for information on their special models. We would appreciate it if you would mention our name when writing manufacturer.

Dirt Mover.—"Iron Mule," the product of the Hughes-Keenan Company, Mansfield, O., is a complete dump unit mounted on the 10-20 McCormick-Deering tractor. In short haul dirt moving this piece of equipment proves its merits in profits. Write to the manufacturer for full particulars, giving the name of our magazine.

Hyatt Roller Bearings.—Used by manufacturers of every type of industrial equipment. The manufacturer, the Hyatt Roller Bearing Company, Newark, N. J., will be pleased to furnish you with names of equipment using this type bearing. They are encased in lubricant tight housings, and designed to eliminate breakdowns and delays. This company has branches in the principal cities.

Hydraulic Hoists. — The Hydraulic Hoist and Body Company, 292 Walnut Street, St. Paul, Minn., will be pleased to send you the name of distributor

Pavements cost less - - - rolled with ERIES

One big saving that you make when you use ERIE Rollers: *Far less time is spent on hand tamping,* because—

The ERIE's compact design, with its much shorter wheel-base and close side and end clearance, make it possible to roll in the "tight places" where ordinary rollers cannot work.

And the ERIE's unique combination of perfect control and instant smooth reversal speeds up the work, and makes it easy to get smooth pavement from curb to curb.

Guaraneed high compression produces uniform hardness. You have fewer bad spots to take up on account of honeycombing—the ERIE's extra weight is built into the roller, with two-thirds concentrated over the compression roll. Just the right diameter for the roll width —no "bridging" and no sinking in.

You're sure of many years' trouble-proof service

When you buy an ERIE you get extra value because of our many years of specialization in roller building. The same inbuilt dependability that has kept many of our "veteran" Steam Rollers on the job since 1888—and still going strong—is found in our Gasoline Rollers, combined with modern improvements to meet present conditions.

Write for our new Roller Book, which shows photos of ERIE Rollers on binder and top course work. And also gives some interesting reports from users, who have found that it pays to use the best rollers that can be bought.

ERIE MACHINE SHOPS
Erie, Pa.

handling their product most conveniently located to give you service, and will also be pleased to furnish you with detailed information about their equipment. Model 5UB is the St. Paul underbody hydraulic hoist, designed for economy of operation with minimum use of power to secure maximum results. Write for information.

Tractor Cranes.—The Industrial Brownhoist Model DC gasoline operated crawling tractor cranes, convertible to shovel, dragline or trench hoe, with capacities from ⅞ to 1¼ yd., is described in literature of the Industrial Brownhoist Corporation, Cleveland, O., and will be sent to you upon request.

Portable Compressors and Pneumatic Tools.—A new feature incorporated in the Ingersoll-Rand gasoline-driven engine compressor during the past year is the "Airsealed" unloader. This makes the portable compressor trouble-free and fool-proof. The "Airsealed" unloader is air-tight, is positive in operation, and works automatically. It is made entirely from non-corrosive metal. Heat, oil and moisture do not affect its operation. The moving parts are made entirely of metal. The "Aftercooler" is a device which insures longer life for the air hose by reducing the temperature of the air after it leaves the air receiver. The "Double V Belts" mean less strain on the bearings, longer life, and a more even transmission of power to the radiator fan. The booklet of this company called "100 and 1 Ways to Save Money with Portable Compressors" just issued in its 7th edition by the manufacturer will be sent upon request. Address the Ingersoll-Rand Company, 11 Broadway, New York, or any of their branch offices. Kindly give the name of our magazine if writing for booklet.

Tractors.—The McCormick-Deering industrial tractors are adaptable for every type of highway equipment. Any of the branches of the International Harvester Company or the main office at 606 S. Michigan Avenue, Chicago, will be glad to arrange demonstration of these industrial tractors at your convenience.

Bins and Batchers.—The C. S. Johnson Company, Champaign, Ill., will be pleased to send you literature giving full details concerning their line of bins and batchers. The bins are built in fully assembled steel units and are always ready for quick erecting or dismantling. The batchers meet all requirements of the State Highway Departments. The scale batchers measure simultaneously the material in each batch and indicate the weight of the volume as well. Write for information, mentioning our magazine.

Kyrock.—The product of the Kentucky Rock Asphalt Company of Louisville, Ky., for building new roads or resurfacing old concrete. For particulars concerning this product write to the manufacturer, kindly giving the name of our publication.

Excavators.—Write to the Keystone Driller Co., Beaver Falls, Pa., for full particulars about this equipment. The electric trip is one of the attractive features of the Keystone skimmer-pull-scoop power shovel. If writing manufacturer for literature, we would appreciate it if you would use the name of our magazine.

Dump Bodies.—Lee Trailer and Body Company, 1100 Lee Road, Plymouth, Ind., have literature which they will be pleased to send you about their motor lift, mechanical hoist dump bodies. Mounted on Chevrolet, Indiana-Truck or Ford Model AA Truck. Write for information.

Industrial Engines.—LeRoi Engines built from 3 to 170 hp. Write for particulars on engine to meet your requirements. LeRoi Company, Milwaukee, Wis.

Loaders and Conveyors.—The Link-Belt "Grizzly" Crawler is designed to produce a reliable, fool-proof, easily operated machine. Write to the manufacturer for particulars about this equipment. Address the Link-Belt Company, 300 W. Pershing Road, Chicago, or 2045 W. Hunting Park Avenue, Philadelphia, Pa. If writing for bulletin, kindly mention our magazine.

Industrial Motors.—The Continental Motors Corporation announce a new series of heavy duty, slow speed Continental engines, especially adapted for industrial uses. Write for special literature on Series H. The booklet "Continental Red Seal" issued by them contains much of interest concerning this product. Address Muskegon, Mich.

Electric Steel Wheels for Every Purpose.—Is the title of a handsome new catalog issued by the Electric Wheel Company of Quincy, Ill. This booklet contains 42 pages of illustrations, prices, sizes and sectional drawings of wheels of every type. Recognizing the fact that wheel requirements are largely of an individual matter, the engineers of this company are ready to study the individual wheel problems, and out of their experience of forty years as specialists in this line, serve your needs. If writing for a copy of this booklet, ask for Catalog No. 25-A. The book contains a long list of catalogs for the various lines, which may be selected from to meet individual requirements, and will be sent upon request. If writing, kindly mention the name of our publication.

Young Unit Heater.—Manufactured by the Young Radiator Co. of Racine, Wis., is a heater with all copper condenser core, adaptable to plants, factories, warehouses, airplane hangars, garages, etc., and is described and illustrated in Bulletin H-108, just issued by the manufacturer. If requesting particulars concerning this equipment, kindly use the name of our magazine.

Graders — Spreaders — Bituminous Distributors—Sand and Gravel Equipment.—Are all treated in separate catalogs recently issued by the Good Roads Machinery Company, Inc., Kennett Square, Pa. The Autograder, illustrated at work on the job and also described in detail, in data form, is shown in Bulletin KAG. The Motograder, a heavy grader attachment, especially designed for use with the Model 20-K "Cletrac" tractor, is described in Bulletin KMG. The Chip Spreader illustrated in KCS, is the trailer traction type, furnished with or without side wing pans, adjustable to suit various height truck bodies. The Catalog on Bituminous Distributors is a handsome 48-page booklet describing the latest development in the mechanical application of tars and asphalts for highway use. The distributors described are built in six models, divided into two types. Type PT obtain power for operating the distributing mechanism direct from a power take-off connected to truck gears on which the distributor is mounted. In Type PU the power is developed by an independent power unit situated on the frame supporting the distributor. Sand and Gravel Equipment is the title of the catalog containing pictures and data concerning modern equipment for speed and economy in Washing and Screening Sand and Gravel. A very elaborate 80-page book. Blue print drawings show various views of process and layout of plants. Many pages of clear, story-telling pictures of plants in operation. Write to the manufacturer for literature to suit your needs, mentioning the name of our magazine.

Paver.—Write to the Foote Company, Inc., of Nunda, N. Y., for full particulars concerning their 1929 Multifoote. For this model a heavier, stronger frame has been adopted, the boom drive has been simplified, the water measuring device improved, and other changes which add speed. We would appreciate it if you would mention our publication if writing manufacturer.

Road Finisher.—The Ord Concrete Finisher, manufactured by A. W. French & Co., 8440 Lowe Avenue, Chicago, is designed to keep down costs and produce and maintain perfect roads. Write to the manufacturer for full particulars about this equipment, kindly giving the name of our magazine.

Trucks.—For every industrial purpose, formerly sold under the name of Graham Bros., are now listed as Dodge Bros. Ask the manufacturer to send you information about them.

Buckets.—A bucket designed for digging where ordinarily picks and shovels are used is described by The Hayward Company, 50 Church Street, New York City. The manufacturers will be pleased to send you detailed information about this product, or their engineering department will give you the benefit of their experience in solving your particular problems. Please mention this magazine if writing.

Wire Rope.—The Hazard Wire Rope Company of Wilkes-Barre, Pa., will be pleased to send you a catalog on prices

RAWLS

1929 HIGHWAY MOWERS

Are a Profitable Investment

It's unsafe to let tall vegetation obstruct motorists' view.
It's wasteful to let obnoxious weeds go to seed.
It's expensive to have mowing done by hand.

Rawls New High-Speed, Heavy-Duty Highway Mower

The Cutter Bars of the New Rawls High Speed Heavy-Duty Highway Mower are operated by a separate gasoline engine. Think of the cutting power! Heavy growth cannot slow down the speed of cutter bars. All the truck or auto does is to tow the mower. This mower has all the exclusive Rawls features.

Cutter bar can be raised or lowered to any angle from straight up to straight down—making shoulders, slopes and ditches easy to mow.

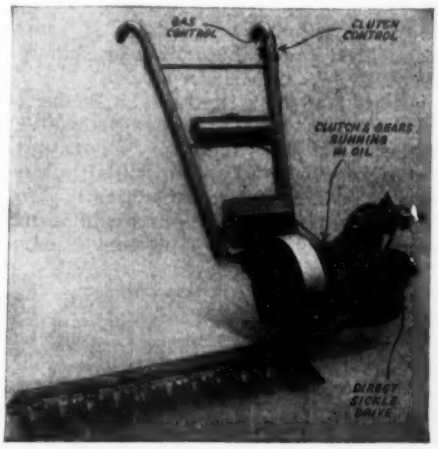
Cutter bar demounts automatically when it strikes an obstruction; can be remounted right on the job in a few minutes.

Write Today for Full Information

Rawls Heavy-Duty Highway Mowers with Axle-Driven Cutter Bars can still be obtained where this type is preferred. Embody all Rawls patented features.

Rawls Mower Type J — Engine Driven Improved!

For mowing where a large mower would be impractical along Highways or in orchards, vineyards, natural parks, etc. It does the work of 15 or 20 men with scythes and goes anywhere a man can go. Power operated and power driven by four-cycle gasoline engine. All the operator has to do is to steer it. Pivots on one wheel, and can be turned sharply to any desired direction. Can also be tilted to cut up and down slopes. Easily handled in rough, close places. Priced low—a real money saver. Write for full information.



Rawls Manufacturing Company

202-210 Iowa Avenue **Streator, Illinois**

MOWING MACHINES EXCLUSIVELY

Cable Address: Rawlsmachy, Streator, Ill.
Codes ABC 5th Ed. and Private

of their Hazard Armored Covered Wire Rope for highway guards and every industrial purpose requiring a high grade wire rope. Write for catalog, giving the name of our publication.

Agrabatchers.—A product of the Heltzel Steel Form and Iron Co., Warren, O. One control operates the sand and stone unit gates and also the upper and lower agrabatcher gates, which are interlocking. A request to the manufacturer will bring you full particulars.

Hercules Engines.—Heavy duty engines for road construction machinery and trucks. Specifications as to types and construction and uses will be sent upon request by the Hercules Motors Corporation, Canton, O.

Tar Heaters.—The Joseph Honhorst Company, 1016 West 6th Street, Cincinnati, O., will be pleased to send you full information concerning their complete line of portable and stationary heaters. If writing for catalog, kindly mention our magazine.

Rollers.—Write to the Huber Manufacturing Company, 335 Center Street, Marion, O., for catalog describing their 4-cylinder motor roller. All parts are fully enclosed but easily accessible. It is operated by single lever control and has a wide range of road speeds.

Hi-Way Guards.—The Page Safety road guard, manufactured by the Page Steel & Wire Company, Bridgeport, Conn. Complete information concerning this product will be sent you upon request by the manufacturer. Kindly give our name if writing.

Roller.—The Pierce Governor Company, Anderson, Ind., have a new roller, and will be pleased to send you literature showing the advantageous features of this equipment. Ask for booklet No. 10, and if writing manufacturer kindly mention our paper. The new product is a compact, lightweight roller, and eliminates the hand tamping in hard-to-reach places.

Calcium Chloride.—"3-0" Calcium Chloride for curing concrete is a product of the Columbia Chemical Division of the Pittsburgh Plate Glass Co., Barberton, O. Roads cured by this method may be opened in seven days. Write to the technical department of this company for any data you may need, and take advantage of the service which they are pleased to render. If communicating with manufacturer, kindly mention our magazine.

Guard Rails.—Write to J. H. Ramsey, 11 N. Pearl Street, Albany, N. Y., for Bulletin B-1 describing and illustrating the Ramsey Safety Guard Rail. An economical highway protection. We would appreciate it if you would mention our publication if writing manufacturer.

Heavy Duty Highway Mower.—The Rawls Manufacturing Company, 202 Iowa Avenue, Streator, Ill., will be pleased to give you full particulars concerning their Motor-Mower, Type J. This machine can be tilted to cut up and down slopes, or turned sharply in any direction, and cutter bar speed is not slowed down in heavy growth. Write for further particulars, using the name of our magazine.

Graders, Scoops, Crawlers, Rollers.—The WARCO products of the W. A. Riddell Company, Bucyrus, O., are fully described in the new 1929 catalog. Write to Department D for your copy, describing the new one man grader, and the new rear crawler. We would like to have you mention our magazine if writing manufacturer.

Maintenance Patrol.—A speedy hot patch outfit for prompt pavement repairs is described in literature of the Rightway Corporation, Builders Building, Chicago. This is a complete miniature asphalt plant. Portable, demountable, self-contained, mounts on any truck or trailer. Everything is contained in one unit, 8 hp. engine, oscillating heating and drying drum, pug mill, power winch hoist, tool heater, fuel oil burners, storage bins, etc. Ask the manufacturer for further information about this equipment, mentioning the name of our publication.

Revolving Tractor Scraper.—"Groundhog," the product of the Roderick Lean Company, Mansfield, O., is adapted to use with any type of tractor. Literature giving full description and prices will be sent upon request. Address Department 12, care of the manufacturer, mentioning our paper.

Graders.—The Rome High-Lift Graders, manufactured by the Rome Manufacturing Company, Rome, N. Y., are designed to cut back slopes without attachments. Write to the Grader Department of the manufacturer at Rome, N. Y., for full particulars about the Rome Graders.

Portable Compressors.—Schramm, Inc., West Chester, Pa., would be pleased to send you literature giving details and prices of their one-piece cast steel frame, and heavy duty engine of large capacity. Compressors are connected by a self-aligning flexible clutch, which permits the starting of the engine without compressor load. This clutch is also flexible in structure so that no wear is thrown on the engine or compressor bearing. If writing manufacturer kindly give the name of our publication.

Adjustable Manhole Top.—The S. E. T. Valve & Hydrant Co., 50 Church Street, New York, will be pleased to send you information about this manhole top, which can be adjusted in a few minutes without digging, and thus greatly reduce pavement repair costs. If writing manufacturer kindly mention our magazine.

Grader Blades.—For all makes of graders or drags, snow plow blades, scarifier and rooter teeth, steel frames and shapes to specifications. Write to the Shunk Manufacturing Company, P. O. Box 37C, Bucyrus, O., for information. Kindly mention this paper.

SKF Ball and Roller Bearings.—SKF Industries, Inc., 40 East 34th Street, New York City, would be pleased to furnish you with data about their bearings, their slogan being "To put the right bearing in the right place."

Paver.—Write to the T. L. Smith Company, 1091 32nd Street, Milwaukee, Wis., for Catalog No. 428 describing the Smith 27-E Paver. This machine has several additional high speed features in advance of the 1928 machine. Write for full information.

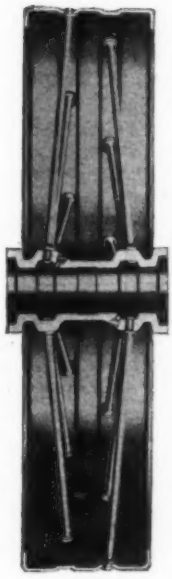
Gas Shovel.—For detailed description and illustration of the Speeder ½-yd., full-revolving, fully convertible, Model B-3 gas shovel, write to the Speeder Machinery Corporation, 1211 South 6th Street, West, Cedar Rapids, Ia. This model features many improvements; greater hoist, crowd, swing and travel speeds, more power and a new simple ultra-positive steering mechanism, electric lights and starter standard equipment. We would like to have you mention our magazine if writing manufacturer.

Tar and Asphalt Heaters.—The Littleford Bros., 454 E. Pearl St., Cincinnati, O., would be pleased to send you information about their 1929 models of their oil burning tar and asphalt kettles. The 1929 model of 84-W is made in 50, 75, 110 and 165 gal. sizes, and has a new double hinged cover that can be opened at either end or entirely removed from the kettle, and can be fastened down securely to prevent splashing of material as the outfit is trailed. Model 78-OB is a 300 gal. Trail-O-Heater equipped with cover for hand spraying attachment. If writing the manufacturer, kindly use the name of our publication.

Semi-Trailer.—The Martin Trailer Company, Westfield, Mass., will be pleased to send you a series of Bulletins describing their trailers and auxiliary equipment. These will be sent to you bound in loose leaf style for additions as they are issued if you request them. Bulletins A, B and C describe the semi-trailers and rocking fifth-wheels. The use of the semi-trailer trebles the capacity of the truck without additional strain on the driving mechanism, and while one is being drawn, another can be loaded and still a third unloaded, all for use with one motor vehicle. The rocking fifth wheel has a crosswise hinge which admits of a longitudinal or fore and aft rocking motion and allows the vehicle to conform to all road unevenness, and this is accomplished without interfering with the stability. Write to the manufacturer for information and literature concerning this equipment. Kindly give the name of our publication.

Hunt Process of Curing Concrete.—This is a process of curing concrete without dirt or water covering. This is done by preventing the moisture in the newly poured concrete from evaporating. Immediately after the concrete pavement has been poured and finished a coating of "McEverlast" Paving Special is sprayed on with a gun. This

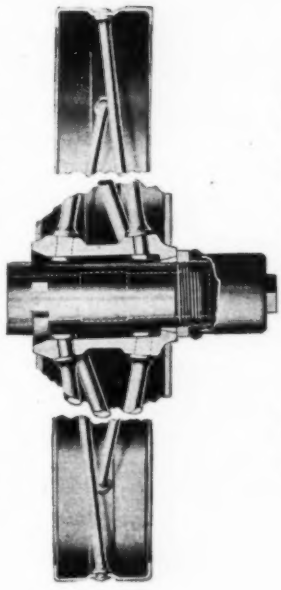
TESTING WHEELS



French & Hecht wheels are designed to best meet the requirements of the machine on which they are used. The hubs may be of cast iron, cast steel, malleable or steel tubing.

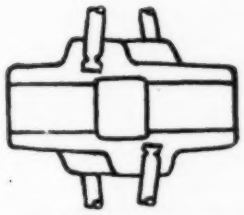
Spokes may be flat, round, or oval, and arranged in the wheel to best meet the load requirements.

Tire sections may be flat, flanged and grooved, concave, convex, half oval, etc., in order to best perform the service desired.

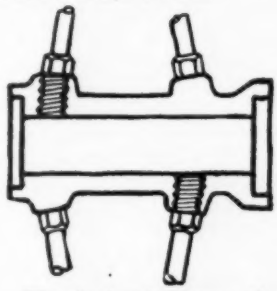


In French & Hecht wheel construction each spoke is heated and forged in the hub, forming a head on the inside and a shoulder on the outside, similar to a boiler rivet.

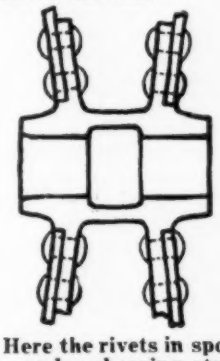
It is expanded in the tire with a shoulder on the inside and the end is riveted on the outside.



Due to well known characteristics of cast iron, it is impossible to secure uniform adhesion or tightness of spoke in this type of wheel. Sounding the spokes in a wheel will reveal the loose ones.



The locknut draws the spoke up so that the threads have a bearing on one side only. Spokes fastened in this manner tend to work loose in the hub. In this type of wheel the spokes are not fastened in the rim.



Here the rivets in spokes are under shearing strain. Also fastening of spokes to rim in this type of wheel offers certain difficulties that are not easily met.

THERE are four common and distinct types of built-up metal wheels. If you have ever examined these different types, after they have been subjected to hard use for some time, you will need no further tests or proofs to judge their comparative merits.

Actual use is the most conclusive test of wheels because continuous shocks and vibration added to the dead strain are certain to reveal in time the weak points in a wheel.

However, simple tests can be made in a shop or laboratory that will show surprising results. Pull out a spoke or two from each hub with a testing machine and see what happens. Follow this with any other tests you have facilities for making.

French & Hecht wheels are actually about 35% stronger than other types of comparable weight because the French & Hecht method of fastening spokes in a hub and tire is mechanically superior, that is why French & Hecht type of construction is so desirable.

FRENCH & HECHT, Inc.

Wheel Builders Since 1888

DAVENPORT, IOWA SPRINGFIELD, OHIO

FRENCH & HECHT

STEEL WHEELS

method completely seals the surface of the concrete and prevents evaporation of the original mixing water. Write to McEverlast, Inc., 111 West 7th St., Los Angeles, Cal., for a copy of Catalog No. 3, giving information about this process. If writing for particulars, kindly give the name of our publication.

Road Rails.—Metal Forms Corporation of Milwaukee, Wis., will be pleased to send you literature describing and illustrating the use of their Metaform road rails, built in the form of a solid tube, with rigid stake boxes and positive joints. If requesting information, kindly give the name of our magazine.

Radiators.—For use on all industrial engines. Write to the Modine Manufacturing Co., Racine, Wis., for information about their Turbotube Radiators. We would appreciate it if you would give the name of our publication.

Asphalt Heaters.—Catalog No. 11 has been issued by the Mohawk Asphalt Heater Co., Schenectady, N. Y., describing their combination tool and asphalt heater. This "Hotstuf" equipment is built with a patented elevated melting chamber. The advantages of this type of heater is fully described in literature. Send for a copy of catalog, mentioning our magazine.

Portable Flasher.—This electric warning light cannot be blown out or drowned out. It is manufactured by the National Carbon Company, Inc., and when operated continuously the Columbia Dry Batteries should last two months. The operating cost is low and the only attention is the changing of batteries every two or three months. Write to the manufacturer at 30 East 42nd Street, New York City, or to any of their branches in regard to this signal. Kindly give the name of our publication if writing.

Concrete Reinforcements.—If interested in a report on the results of the use of welded steel fabric in road work, write to the National Steel Fabric Company, 1811 Union Trust Building, Pittsburgh, Pa., asking for a copy of their book on Application of Results from Road Surveys. National reinforcing product is adaptable to every kind of reinforcing concrete work. This book will be sent to you without obligation and we would appreciate it if you would kindly mention our magazine if writing for it.

Resiliflex Road Guard.—A product of the National Traffic Guard Co., 215 Moreland Ave., N. E., Atlanta, Ga. A flexible, smooth surfaced safety traffic guide. All rail sections are completely interlocked with double hinge joints, making continuous structure, and springs support Resiliflex rails 6 in. from posts to prevent vehicles from colliding with posts. All parts are galvanized for rust protection. Write to the manufacturer for complete information on this product, giving the name of our magazine.

Snow Loader.—The Nelson Snow Loader has a capacity of 10 to 15 yd. a minute in new snow and 5 to 8 yd. in old refrozen snow. It works uphill or down in ice, snow or slush. Write to the manufacturer, the N. P. Nelson Iron Works, Inc., 821 Bloomfield Avenue, Passaic, N. J., for detailed information. Kindly use the name of our magazine.

Flood Lights.—For night work. Write to the Oxweld Acetylene Company, 30 East 42nd Street, New York City, for information about their Carbic Flood Light. This light has only three parts and any inexperienced laborer can charge it in a few minutes. A charge lasts twelve hours. Its operating cost is low. If requesting particulars of the manufacturer kindly mention our magazine.

Drag Shovel.—The Page Engineering Company, 844 Rush Street, Chicago, will be pleased to send you complete information in regard to this equipment. The Page Drag Shovel attachment grades with long, flat, horizontal strokes and makes an excellent device for tearing up old macadam or concrete roads. If writing manufacturer kindly give the name of our paper.

Metal Lath and Reinforcements.—The Union Steel Products Company of Albion, Mich., have just issued a handsome 16-page booklet describing and illustrating their building specialties. Reed clips, form spacers, column tie units, beam bar spacers, slab bar spacers, lath hanger, straight wire lengths, special wire shapes are some of the products described in this book. The bulletin contains a list of buildings using Reed clips, and a table of sizes to meet every requirement. If asking for a copy of this catalog specify No. 227. Their engineering department will be pleased to quote on any special wire or light metal building specialties, if furnished with specifications. If writing the manufacturers, we would appreciate the mention of our publication.

Loaders, Conveyors, Ditchers, Etc.—"Loading Layouts, Ditching Snapshots and Records" is the title of a very attractive booklet issued by the Barber-Green Company, 510 West Park Avenue, Aurora, Ill. This equipment is illustrated at work and records are given. Construction of machinery and specifications are given. Write for a copy of this book, giving the name of our magazine.

Industrial Engines.—The Stearns Motor Manufacturing Company, Ludington, Mich., will be pleased to send you upon request a set of Stearns Engineering Bulletins, fully describing and illustrating by pictures and cross-sectional drawings the Stearns engines for all industrial purposes. Write for this literature, giving the name of our magazine.

Stover Engines.—The Stover Manufacturing & Engine Company, 27 Lake Street, Freeport, Ill., have issued literature describing their entire line of industrial engines, illustrating and pointing out the advantages of their new horizontal-type completely enclosed Stover engine. It automatically lubricates not only the piston and cylinder, but all other moving parts by a splash system. If writing for information, kindly mention our publication.

Steel Posts.—Upon request, Sweet's Steel Company, Williamsport, Pa., will be pleased to send descriptive catalog concerning this product. These posts are rolled from the highest grade carbon steel, easy to drive, and self-contained, and afford a high degree of safety. Kindly use the name of our paper if writing manufacturer.

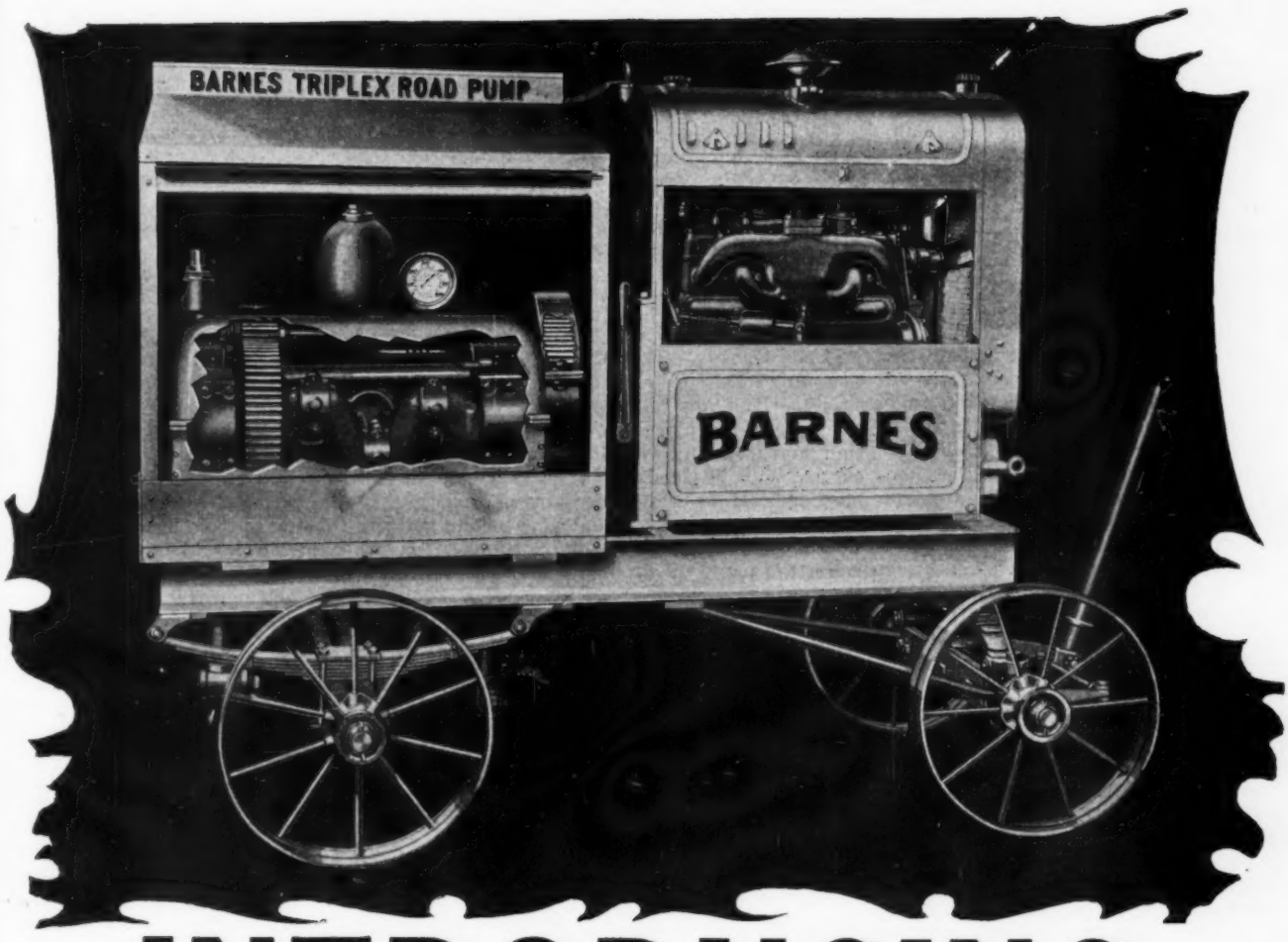
Tar Kettles, Carriers, Etc.—The Tarrant Manufacturing Company, Saratoga Springs, N. Y., will be pleased to send you new catalog with full particulars about their complete line of products, such as brick filling pots, asphalt kettles, can carriers, cans, sidewalk sanders, etc. If you write to the manufacturer, will you kindly mention our magazine.

Roller Bearings.—If desiring statistics in regard to roller bearings, write to the Timken Roller Bearing Company, Canton, O., who will be pleased to send you full particulars. Equipment for road building must be able to stand abuse and shocks, and an important feature in construction of shovels, pavers, graders, mixers, etc., is the type of bearings used. If writing to the manufacturer for information in regard to their product, kindly use the name of our paper.

Torches and Stampings.—Literature from the Toledo Pressed Steel Company, Toledo, O., gives full description and illustrations of our new Toledo torch, which rights itself from any position and is a guarantee from injury damages. For night work this torch is a great safeguard. When equipped with the Economy Burner, the burning time of this torch allows a safe margin for week end service. Write for literature, using the name of our magazine.

Formgrader.—Manufactured by Ted Carr & Company, 939 North Avenue, Chicago, will successfully dig ordinary old macadam or any soil from 4 to 700 ft. per hour, cutting a level, flat trench 12 in. wide up to 12 in. deep. This machine is fully described in a folder issued by the manufacturer. Kindly mention our paper if writing for information.

Power Plow Scrapers.—The Engineering Department of the Garst Manufacturing Company, Chicago, Illinois, have prepared literature on the reasons why their Power Plow Scrapers cut handling costs. These plow scrapers dig as they convey and are good for all kinds of soils. They can be operated efficiently by one man or two men. They have an operating radius of 400 feet, and not only convey to a central delivery point but are widely used for storing material. Much interesting information about these plows will be furnished by this company upon request.



INTRODUCING

The Greatest Barnes Pump

Barnes High Pressure Pumps have gained an enviable reputation as a result of their reliable performance during the past ten years. But not content with this achievement, the 1929 pump embodies a new design, which, retaining all proven features of the earlier models, gives greater value.

The following are some of the reasons for Barnes supremacy:

1. Crank shaft guaranteed against breakage.
2. Specially designed plungers, positively prevent water leakage into crank case.
3. Roller Bearings on all shafts, including crank shaft.
4. All working parts, including plungers, completely enclosed.
5. Self adjusting multiple disc clutch.
6. Most simple, self-oiling system—one moving part rotary pump.
7. All steel gears with heat treated pinions.
8. Three point suspension truck, spring mounted.
9. Detachable water cylinders.
10. Flexible coupling between pump and engine.
11. Quickly demountable power unit.
12. Rubber tired roller bearing wheels, interchangeable with standard steel wheels.

THE BARNES MANUFACTURING CO.
11901 Main St., MANSFIELD, OHIO

BARNES PUMPS

Mail This Coupon for Complete Data

The Barnes Manufacturing Company,
901 Main Street, Mansfield, Ohio.
Please send me complete descriptive literature covering Barnes Road Pumps.

Name.....

Address.....

City.....State.....

Stanolind.—Write to the Standard Oil Company of Indiana, 910 South Michigan Avenue, Chicago, for information concerning Stanolind Cut-Back Asphalt as an aid in resurfacing macadam.

Crushers.—Catalog No. 3C, presented by the Bakstad Crusher & Equipment Corporation, Chicago, is just off the press. This is a very handsomely assembled booklet on the 3-Jaw Crusher, a unit having three crushers in one; a primary and two secondary crushers, actuated by the same mechanism required to operate one crusher. This is accomplished by the addition of only two principal parts. The bulletin gives detailed description and illustration of the machine and its parts, with some very convincing testimonials from users of this equipment. The booklet contains an inquiry blank to be filled out stating just what your requirements are in order that your individual problems may be solved when literature is sent you. In writing for this catalog, kindly give the name of our publication.

Excavating.—A limited edition of a copyrighted piece of literature called "Excavating in Pre-Drained Wet Soils" is yours if you care to write to the Domestic Engine & Pump Company, N. Queen Street and P. R. R., Shippensburg, Pa., and request that a copy be sent to you. This booklet contains valuable information for engineer and contractor. We would appreciate it if you would mention our publication when writing for a copy.

Four Wheel Trailers with Under Body Hoists.—The Fruehauf Trailer Company, 10937 Harper Avenue, Detroit, Michigan, have some interesting data on the Fruehauf System of Low Cost Haulage. This engineering information, together with illustrations showing just what their products can accomplish in unloading problems, will be sent upon request. There is no obligation, simply address Mr. W. B. Chapoton at the above address.

Rotary Fresno.—The Western Rotary Fresno hauls up to 200 yards and is to be used with small, fast tractor, both operated by one man. It is a model of efficiency in earth moving. For particulars concerning this equipment write for Bulletin 28BRS, Western Wheeled Scraper Company, Aurora, Illinois.

Graders.—The Galion Iron Works & Mfg. Co., of Galion, Ohio, issue fully illustrated literature describing the Galion E-Z Adjustable Leaning Wheel Graders. The latest patent covered improvement on this piece of equipment is the Automatic Pivotal Rear Axle. This company will be pleased to send you information concerning this machinery. If writing kindly mention our magazine.

Crushers.—The Iowa Manufacturing Company of Cedar Rapids, Iowa, issue a complete catalog treating of crushers and crushing equipment for handling rock, sand and gravel. Their one-piece outfit in one operation crushes, screens and loads. Write to Mr. John H. Jay, Iowa Manufacturing Company at Cedar Rapids for a copy of this catalog if interested in this type of equipment. If you will mention Roads and Streets when writing, we shall appreciate it.

Road Guards.—The Cyclone Fence Company offer to any one interested specifications and details for working out safety campaigns. This information is based on programs now being carried out by leading highway commissions. If desiring this information, write to Mr. G. H. Kinney, Cyclone Fence Company, at Waukegan, Illinois, using the name of our magazine.

Crushers.—Write for Catalog No. 153, concerning Telsmith Primary Breaker, and 2F3 on the Telsmith Reduction Crusher, issued by the Smith Engineering Works, 82 Capitol Drive, Milwaukee, Wis. The great crushing capacity of this equipment is accounted for by its great feed area. These bulletins are free, and will be sent without obligation if you will kindly mention Roads and Streets.

Seal Tight Expansion Joints.—The necessity for expansion joints, types that have been used, types of premoulded joints, etc., are discussed in a little booklet called Seal Tight issued by W. R. Meadows, Inc., Elgin, Illinois. Allowances must be made for the expansion and contraction of concrete as affected by weather conditions, and this booklet gives results as accomplished with Seal Tight in controlling this problem. Write to Mr. W. R. Meadows at Elgin for complete information regarding these expansion joints, mentioning the name of our magazine.

Dual Drive Motor Grader.—The tractor in the Austin Dual Drive Motor Grader is mounted on four wheels instead of two, and all of these are drive wheels, and is a unit entirely separate from the rest of the machine. A complete description of the construction and operation of this equipment will be mailed upon request by the Austin-Western Road Machinery Co., 400 N. Michigan Ave., Chicago. The dual drive features of the grader contribute to more power, more traction, freedom from skidding or miring, and operates efficiently and economically on soft, wet or rough ground. Literature on this type grader will be found of interest to all users of grading equipment. If writing to Mr. H. F. Barrows of the Austin-Western Company for this information, kindly give the name of our magazine.

Steel Wheels.—For use on graders, maintainers, tractors, trucks, trailers, scrapers, wheel barrow, carts, etc. French & Hecht, Inc., wheel builders, of Davenport, Iowa, and Springfield, Ohio, will gladly furnish information concerning wheels to meet any requirements or design. For this detailed information write to this company at either of their plants, mentioning the name of this magazine.

Trailers.—The Rogers Brothers Corporation, 116 Orchard Street, Albion, Pa., have just issued a new catalog describing the practical features of the Rogers Goose Neck Heavy Duty Trailers. It is made in capacities from 5 to 100 tons and built to carry loads in excess of ratings. For economically moving steam shovels, cranes, ditchers or other heavy machinery this heavy duty trailer is built to serve. When writing for the new catalog, we would appreciate your mentioning this magazine.

Cement.—Of interest to the cement users is the new booklet issued by The Universal Portland Cement Company, called High Early Strength Concrete. This booklet gives full details for securing strong concrete in three days with the usual materials and labor. Write to Mr. Charles S. Rye of the Chicago office of the Universal Portland Cement Company for a copy of this booklet. We would appreciate your mentioning our magazine if writing.

Tarmac.—A product of the American Tar Products Company for cold or hot surface treating, there is a grade for every highway need. This company has branch plants located over the country in order to insure prompt shipment to meet the highway engineer's needs. Write to the American Tar Products Company at Pittsburgh, Pa., for particulars concerning this product and the nearest distributor.

Gas Shavel.—The Ohio Power Shovel Company, Lima, Ohio, will send upon request descriptive literature about the Lima "101" gas-shovel with capacities of 1 yd. and 1¼ yd. Kindly mention Roads and Streets magazine if writing to Mr. Grant Davis, at Lima for this information.

Shovels, Cranes, Dragline, etc.—The General Excavator built for service as shovel, clamshell, dragline, backhoe, skimmer, crane or backfiller may be thoroughly investigated by calling on any of the distributors for this equipment, which is manufactured by the General Excavator Company, Marion, O. Write to Mr. F. B. Morrison, care of the General Excavator Company, for the name and address of the nearest distributor. Will you use the name of our paper if asking for information?

SAVE YOUR TIME! USE OUR SERVICE! Prices on equipment, names of manufacturers or their catalogs will be cheerfully furnished to you by our Service Department. Write Roads and Streets, 221 E. 20th St., Chicago.